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Research Needed in Ferrous Engineering Materials

NEW industrial processes, many of them in the field of chemical engineering, are creating an increasing demand for new steels and steel alloys possessing special properties. The trend in ferrous engineering materials is toward the development of special metals and alloys for highly specialized uses. No longer are mere chemical analyses and mechanical tests the criteria for engineering steels. Thermal expansion, magnetic properties, electrical resistance, reflection of light, and resistance to corrosion, erosion, heat and chemical action are some of the qualities which, single or in combination, are now demanded in ferrous engineering materials. The era of special problems is at hand.

SPEAKING at a dinner of the Engineering Foundation some time since, Dr. John A. Mathews, vice-president, metallurgist and director of research and development for the Crucible Steel Company of America, emphasized the widening scope of engineering requirements in steels, stressed the lack of fundamental data and the need of extensive research. Just how meager is the information on these materials demanded by modern industry, and how scanty and inadequate the established data, was not realized until joint conferences of the A.S.T.M. and A.S.M.E. reviewed the field two years ago. Out of those conferences grew a joint research committee which has since laid out a program of co-operative investigations.

A SURPRISING fact in the existing situation is the comparatively insignificant part played by the steel industry per se in metallurgical research. It has assumed no leadership; it has made few conspicuous contributions to scientific knowledge. Production of special steels has been forced on it from without. Consumers, faced with puzzling problems, have solved them as best they could with little aid from a highly standardized industry devoted to mass production. Contrast this condition with that obtaining in the non-ferrous metal industries, where research is supported in generous measure and where producers aid in the solution of consumers' problems.

IT IS probably for this reason that Dr. Mathews finds himself the sole producer of steel on the research committee mentioned above, the other members being users. There is hope for the future, however, in his advanced ideas about steel making, for he holds that "the one who meets all these diverse (material) needs of industry should be a physicist, but the man who makes the steel itself should have a physico-chemical training." Viewing the broader field, he sees that "metallurgy is fast becoming a branch of physical chemistry and a very important one, but unfortunately that fact does not seem to be generally recognized."

THE research program of the joint committee is worthy of support by both makers and users of ferrous engineering materials. Its financial program is modest —the expenditure of $50,000—and would be wholly inadequate but for the co operation of university and industral laboratories. As Dr. Mathews points out, America has not done its part in developing "the background of established data and physical constants" in this department of metallurgy. The opportunity to join in a co-operative effort in a modest way is thus offered to those companies that otherwise make no pretense at supporting private research programs.

Insurance Against Another Lake Denmark Explosion

INVESTIGATION of the disastrous explosion that cost more than a score of lives and destroyed at least fifty million dollars worth of government property at the naval ammunition depot at Lake Denmark, N. J., must not end with the official whitewash by the Navy's own Court of Inquiry. The chemical engineering profession cannot accept an "act-of-God" explanation as the last word in a situation that apparently involved many human violations of recognized engineering practice in the storage and handling of high explosives. Public interest demands the most effective effort to prevent a possible recurrence of this tragedy.

Granted that lightning is a menace not yet wholly subject to human control, there remains the necessity for explaining the vicious conditions that made the firing of a single explosives magazine the priming charge for a series of explosions and fires of unequaled severity. What were these conditions and who was responsible for them?

In an area considerably less than one square mile there were crowded 200 buildings in which were stored $84,399,506 worth of munitions consisting of loaded and fused shells, depth charges, aerial bombs, mines and torpedoes in addition to tremendous stores of T.N.T., ammonium picrate, black powder, picric acid and smokeless powder. The Court reported that this ammunition was segregated in various magazines in accordance with Bureau of Ordnance instructions. But is it conceivable that these instructions should contemplate the conditions that actually existed at Lake Denmark? The testimony showed that temporary magazine No. 8, the first to explode, contained in addition to bulk explosives more than 1,000,000 lb. of cast T.N.T. in depth bombs, and that 50 ft. away 2,000,000 lb. of the same explosive was in magazine No. 9 which exploded a few seconds later. Eight other magazines contained from 700,000 lb. to 2,500,000 lb. of explosives in bulk as well as aerial bombs and loaded and fused projectiles.

The appalling threat of such overcrowding is better appreciated when it is recalled that the New Jersey State law—which is accepted by the explosives industry as a reasonable and safe precaution based on actual experience—provides that it is illegal to store in any one magazine more than 30,000 lb. of loose or more than 250,000 lb. of packaged explosives, such as T.N.T. The same law further provides that magazines which contain 250,000 lb. of explosives must be distanced from other explosives by at least 800 ft. Yet at Lake Denmark, temporary magazine No. 8, overstocked by at least four times the quantity legally permitted in the State of New Jersey, was not more than 50 feet away from magazine No. 9 which was even more seriously overcrowded. "Extra-territoriality" is the legal loophole which permitted the United States Navy to indulge in practices that would have landed a private manufacturer in jail!

"In the light of present knowledge," the Court reports, "the area of the Lake Denmark depot is too small and its situation is too near inhabited land for safe storage of more than small amounts of high explosives." Therefore it recommends the substitution of two new ammunition depots each covering an area of 100 square miles—or 150 times the size of the ill-fated Denmark. In other words, the Navy is now about to increase its factor of safety by 30,000 per cent. From the Court's statement, however, the layman naturally assumes that no knowledge or experience existed prior to July 10, 1926, that might previously have guided the Navy to such a decision. There is no apparent recognition of the fact that for 15 years the explosives industry, the railroads and the industrial users of explosives have accumulated a vast fund of experience that has been summarized in the American Table of Distances—the basis of which was a careful study of more than 500 separate explosions, for 135 of which accurate measure of structural damage has long been available. This table of distances states that magazines containing 1,000,000 lb. of explosives must be 3,455 ft. distant from any inhabited building, assuming the magazine is either naturally or artificially barricaded. If it is not, the table provides that the distance should at least be doubled. At Lake Denmark, officers quarters were within 100 yards of magazines 8 and 9, and there were no barricades!

Perhaps the Navy regards the American Table of Distances merely as a private treaty between the explosives manufacturer and the railroads, but can the Navy be as easily excused from its failure to observe certain very definite precautions which the Government itself had helped to provide? At the peak of the War emergency, representatives of the War and Navy Departments, the Institute of the Makers of Explosives, State regulatory authorities, and the National Board of Fire Underwriters met in New York City to discuss the storage of smokeless powder and explosive munitions. The very first of the recommendations of the conference reads:

> 1. That high explosives storage, because of its explosive and detonating character, be limited, when practicable, to 250,000 lb. in any one magazine; magazines to be located in conformity to the American Table of Distances. Storage magazines to be not nearer than 2,000 ft. to projectile storage.***

Other important questions, such as the type of magazine construction and the excessive use of flammable material in roofing, sheathing, shelving, wooden containers and flooring, must be answered before there is a final accounting of past responsibility and an adequate guarantee of future protection. But sufficient facts have been cited to establish the need for a thorough engineering investigation, quite apart from the patriotic emotions stirred by any account of the heroic behavior of those unfortunate officers and men who faced death in a manner worthy of the highest tradition of their service.

The President has it within his power to appoint an impartial board, properly qualified to study the disaster itself, the conditions that existed at Lake Denmark and which now obtain at other governmental arsenals, and, what is most important, the underlying faults in the departmental machinery that permitted flagrant violations of established engineering practices. Congress, too, must take a real interest in such an inquiry. If justified by the facts, a federal statute should be enacted either fixing the maximum storage and minimum distances for government magazines in accordance with safe practice, or forcing the Army and Navy Departments to comply with the laws of the state in which they operate. Only such action can insure the public against a possible recurrence of this tragic sacrifice of life and property.

Why Welding Should Be More Extensively Employed

WELDING, both in the fabrication and repair of chemical engineering equipment, has made rapid strides forward in recent years. This development found its roots in the war, when, for a number of reasons, the courage to adopt new methods was more readily found than in peace times. Perhaps because of this background, however, the reasons for the extensive use of the method are not well understood and welding is today far less used than it should be.

A wide use of welding has its justification in the most elementary and fundamental of economic considerations —reduced costs. This is probably well understood in so far as repair work is concerned, for it is unusual today to encounter a plant that does not use welding in making repairs. Also, the employment of welded pipe lines is becoming such a common practice throughout the field that one looks to see it universal before long. But when it comes to the adoption of welded process equipment, there seems to be much hesitation. Custom has long decreed the use of cast or riveted construction for such apparatus and it is going to take both the driving force of economic necessity and a full realization of the advantages to be obtained to change such habits.

Where economic necessity enters is obvious, for a plant that uses less expensive equipment should be in a position to sell its products at a lower price. The advantages of the welded equipment may not be so obvious. These advantages all flow from three things: The welded joints have very nearly the same strength as the metal itself, the joint is leakproof, and welding permits the substitution of steel for cast iron. The advantages derived from leakproof joints are evident. The first advantage derived from the other two factors is that welded equipment of the same strength will weigh from 20 to 50 per cent less than riveted or cast equipment. This gives a direct saving in the first cost of equipment which materially reduces the overhead. A second reduction in the cost of equipment flows from the fact that less labor is necessary in the fabrication of welded equipment. The combined results of the two factors in reducing overhead will have a marked effect on the competitive position of the plant using welded equipment. An additional advantage comes from the lower weight of equipment made by welding, because such equipment requires much less expensive foundations or supports, thus reducing the expense of constructing new buildings or increasing the amount of equipment that can be supported on existing structures.

That these advantages are not generally realized can be shown by some examples from current industrial practice. In one case a recovery process was developed in semi-plant scale equipment made completely of welded steel. The process proved feasible, and full-sized commercial plants have been constructed in which the fully satisfactory welded experimental apparatus has been replaced by riveted steel and cast steel and iron units. In another case, an experimental carbonization plant was built entirely of welded materials while the commercial unit that grew out of it made little use of welding, even using riveted gas pipes and storage tanks. These illustrations make it evident that the habit of years is not easily broken and, even when it is known that welding will be satisfactory, many engineers instinctively follow the accustomed practice.

There are, however, signs of dawn on the horizon. Some engineers and some plants are awake to the advantages that can be derived from welding and are rapidly widening their use of this method. The results that they achieve cannot fail to be a strong inducement to the more conservative brethren to follow suit.

Needless Abuse of Methanol

METHANOL has long been used as a denaturant of ethyl alcohol, probably for 20 years. It was so used before the adoption of the Eighteenth Amendment and the passage of the Volstead Act. From the Government's point of view the purpose of denaturing was to permit diversion of alcohol to certain industrial uses without evading the revenue laws or paying the excise tax. There was no thought then of balking the bootlegger or rendering alcohol unfit for beverage purposes. But that was in the pre-emotional era of the alcohol industry in the United States.

With the advent of prohibition methanol was continued as one of the denaturants because it is almost ideal for that purpose, both for industry and the Government. That it was poisonous was well known; in fact that knowledge probably became more widespread after prohibition than ever before. But this did not deter the bootlegger from marketing denatured alcohol either with or without any attempt to remove the methanol. Both he and his dupes were willing to take the risk. Neither conscience nor prudence characterized their nefarious trade, whose standard was obviously "Caveat Emptor."

Recently the organized opponents of prohibition have raised a cry against poisonous bootleg liquor and laid the blame on methanol. Senator Reed, interrogating Dr. Doran, chief chemist of the prohibition unit, intimated that the Government, in countenancing the use of methanol as a denaturant, was "enforcing prohibition by poison." And the Association Against the Prohibition Amendment has not hesitated to display the incident unfairly in a flamboyant poster printed evidently for the use of avowed "wet" candidates for office.

This agitation on the part of the anti-prohibitionists, coupled with the fight of the prohibitionists against industrial alcohol catches the two industries between the upper and nether millstones. Each side pillories a product in an effort to advance its own cause. Both are betrayed by their emotions into utter disregard of the welfare of industries serving a useful purpose and entitled to better treatment. It seems unlikely that all the evils in the train of the prohibition movement can have been caused by industrial alcohol and methanol.

Let's play fair with these industries and consider their products rationally and with less emotion. Methanol is used as a denaturant in the United States in much lower percentages than in Canada, for example. The highest authorized percentage of methanol in U. S. formulas is only 10 parts to 100 parts ethyl alcohol and ½ part benzine. Canadian regulations for completely denatured alcohol call for the addition of 30 parts methanol to 70 parts ethyl alcohol, while the specially denatured grade, for the use of which a special license must be obtained, contains 20 per cent methanol.

As previously emphasized in these columns, *Chem. & Met.'s* interest in this matter is solely that of fair play for industries that should not be needlessly entangled in the meshes of prohibition enforcement.

Producing Bleaching Powder by the Backman Process

Low labor and maintenance cost, ease of chemical control, simplicity of operation, economy of power and uniformity of product are among advantages claimed for this recent development

By Gösta Angel
Civilingeniör, Bohus, Sweden

SOME years ago in Hudiksvall, Sweden, a kind of mechanical bleaching powder plant was erected. This was interiorly provided with shelves, and the lime was transported from one shelf to the next, and so on. However, this construction did not work satisfactorily, and the company was faced with the problem of building a new and better bleaching powder plant. This happened in the latter part of the War, during the years 1916-1917. The chief engineer at the plant, Mr. Backman, constructed a new mechanical apparatus according to his own design, which will be described herewith.

The type chosen was much similar to a pyrite furnace, Fig. 1, i.e., a tower with several intermediate floors and a central, vertical shaft, provided with scraper arms, causing the lime to move from one floor to the next in a direction counter-current to the chlorine. The idea was close at hand, as the chambers of the original plant were constructed for the transportation of lime from shelf to shelf, although by aid of a much more complicated mechanical device.

In 1917 a circular trial tower was erected. The material used in the walls was brick, with wood in the intermediate work. After some experimental work, a suitable type of scraper arms, feeding device, etc., was found. The results obtained with the first tower was so encouraging that an additional series of chambers was erected, also employing brick. By an unfortunate accident, however, a large quantity of hydrogen got into the chlorine gas, with the result that a severe explosion took place and the brick towers were completely destroyed. However these were soon rebuilt and Mr. Backman obtained through this accident an exceptional opportunity of utilizing the practical experiences learned with the old towers which were reconstructed in a much improved state. Mr. Backman was so sure of a success that the new chambers were constructed of reinforced concrete. To carry off the heat of reaction, the dilution of chlorine gas with air was still the only apparent method and the 5 concrete chambers were therefore erected a short distance apart to allow the surrounding atmosphere to circulate.

It was soon realized that the cooling of the chambers, through the atmosphere and through dilution of the chlorine gas, was insufficient. Cooling coils were therefor imbedded in the intermediate floors, and the influence of temperature upon the process, was carefully studied.

Mr. Backman has transferred the sole exploitation rights of his patents to Krebs & Co. A/S., Oslo, Norway, which has constructed, or is constructing, bleaching powder plants for the following concerns:

Chem. Fabrik Dr. Hugo Stoltzenberg, Gräfenhainichen, Germany; Société d'Electro Chimie, Jarri, France; De la Société de St. Gobain Wasquehal, France; Société Industrielle de Produits Electrochemique Bozel-Lamotte, Cuise-Lamotte, France; Jan Dekker, Wormerveer, Holland; Fabriques de Produits Chimiques de Thann et de Mulhouse, Thann, Alsaze.

Electroalkali, Hudiksvall as well as Elektrokemiska

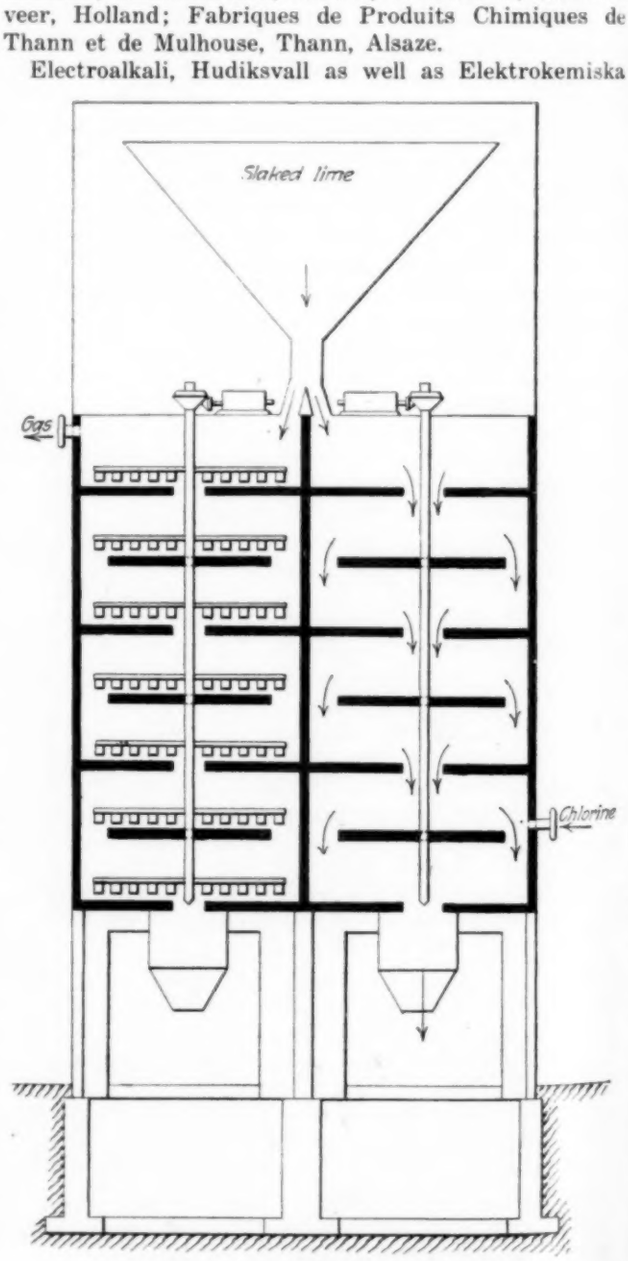


Fig. 1—Backman Chlorinating Chamber

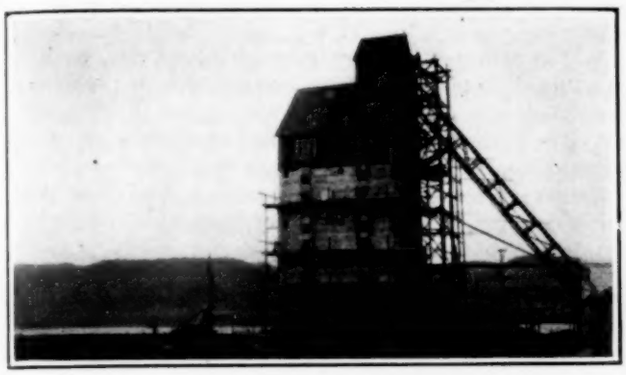


Fig. 2—Backman Chambers at Bohus

Aktiebolaget, Bohus, have both later increased the number of their Backman chambers.

Figs. 2 and 3 show the exterior of the Backman chambers in Bohus and Gräfenhainichen respectively. The chambers are constructed from reinforced concrete with the exception of the topbuilding, in which the lime silo and the lime feeding device are placed, and which may be constructed from either wood or brick. As a difference of 50 deg. C. may arise between the temperature inside the chambers and that of the air, it is important that the work is accomplished in the right way. The coating of the inner walls, which is made to prevent the corroding influence of the chlorine and bleaching powder must be carefully done. No fretting can be observed on the 8-year-old concrete walls in Hudiksvall, and any repairs have not been necessary except around the windows.

The chambers are constructed with a square section and two parallel rows are put together. A reduced cost of construction is thus realized, and a large gas volume is obtained. In the corners between two intermediate floors, a worker may stand erect, a fact being of great importance durihg the time of erection and during eventual later repairs. In each intermediate floor is a window, large enough to serve as an entrance. For each second floor, balconies are running along the outside of the chambers. The distance between each floor is sufficient to allow an easy mounting, and easy repairs, and the large volume serves also to even out variations in the supply of gas and to even out temperature fluctuations.

As the content of hydrogen in the chlorine, especially when mercury cells are used, may cause explosions, the windows also serve as a safety device.

The scraper arms are made from iron, treated in a special way. In the lower floors they last at least 6 months, and in the upper floors several years. They are easily replaced, of simple construction and cheap. The maintenance cost of the machinery is about $150 to $250 a year for each chamber.

The central shaft to which the scrapers are connected, is most suitably driven by a direct-current motor by which the speed may be regulated. On account of the slow speed, the power consumption is extraordinary low, only 0.2 to 0.3 kw. for each chamber.

The lime is automatically fed from a silo. The feeding device is driven from the same motor as the central shaft. Through a very simple means the clearance of the scrapers above the different floors, may be changed while the chambers are running. This is of importance if the rotation of the scrapers is made difficult through lime deposits on the floors. This does, however, happen only if the humidity of the chlorine is too high, or the lime is too wet, or if humid air is sucked in. It may at once be observed through a greater power consumption of the motor. This is remedied by lifting the scrapers, an eventual cleaning being postponed to a suitable time.

In this connection it may be mentioned that the chambers have been run for 6 months without any interruptions of any kind, and without having been opened for inspection. However, it is recommended to inspect the interior of the chambers 3 or 4 times a year. For this reason each plant ought to have one chamber in reserve.

The finished product is collected in a silo below the chambers. This silo is so constructed as to store at least the production of 16 hours. The emptying of the finished bleaching powder may thus always be done during the daytime. During the night the chambers work automatically. The time required to fill a cask is only a few moments, and it is carried out without any dust trouble. The chambers ought to be built at such a distance above the ground, that the cask may be rolled directly into railway cars.

The chlorine is introduced into the chambers in the second and third floor, counted from below. The waste gases are sucked out from the upper intermediate floor by means of an exhauster. This causes a slight vaccum inside the chambers, so that any smell of chlorine in the neighborhood is avoided.

A very important part is played by the cooling coils, which are imbedded in all the intermediate floors except the upper one. Cold water or brine circulates through the coils. The brine being artificially cooled.

The temperature has as known an important influence upon the production of bleaching powder. According to the investigations of Lunge, 40 to 45 deg. C. is the optimum temperature. In practice, it is however observed, that it is far better to produce a good bleaching powder when keeping a lower temperature. These two statements thus seem contradictory. An explanation of this very important question might therefore be of interest. The production of bleaching powder is influenced in 3 different ways by an increased temperature:

1. The speed of reaction with regard to the formation of bleaching powder is increased.

2. The changing of hypochlorite into chlorate is favored.

3. The bleaching powder breaks down into chloride and oxygen.

Normally, that the speed of reaction should increase with an increased temperature, and this is also in accordance with the investigations of Lunge, until a temperature of 45 deg. C. It is, however, most probable that the speed of formation with regard to the bleaching

Fig. 3—Backman Chambers at Gräfenhainichen

powder is further increased. The other two reactions, however, can simultaneously take place, and the total yield of bleaching powder is thus caused to decrease.

Many textbooks state that the reaction between chlorine and calcium- and alkali hydroxides yields hypochlorite in a cold state, and chlorate in a hot state. This is true with modifications. The fact is that the temperature plays less rôle than the amount of alkali present. It has been known for a long time in the chlorate industry, that as long as we have an excess of hydroxide, the formation of chlorate is negligible. And this fact holds true for bleaching powder in solid form as well as in solution. Even if boiling a solution of an alkali hypochlorite for several hours, only a small part is converted into chlorate. If all the alkali hydroxide is neutralized by the chlorine, or if the solution is acidified or an excess of chlorine is introduced, the speed of reaction of the chlorate formation is increased with the temperature. The oxidizing to chlorate is, in other words, made easier by the presence of free HOCl than by hypochlorite. Any chlorine in the presence of water, acts as an acid, according to the following equilibrium:

$$2\ Cl_2 + 2H_2O \rightleftarrows 4\ HCl + O_2$$

In this connection, attention is called to the well known fact in bleaching powder production, that if continuing the chlorination of the lime too long, the percentage of available chlorine is reduced, while the formation of chlorate simultaneously is favored. In this reaction, heat is developed and this in turn increases the speed of the reaction. If, therefore, the formation of chlorate once is started it often continues very rapidly, until little of the available chlorine is left.

The thermochemical equations for the formation of potassium hypochlorite and chlorate are given below. Those for calcium are analogous:

$$6\ KOH,\ aq + 3\ Cl_2 = 5\ KCl,\ aq + KClO_3,\ aq + 97.6\ Cal.$$
$$6\ KOH,\ aq + 3\ Cl_2 = 3\ KCl,\ aq + 3\ KOCl,\ aq + 73.8\ Cal.$$
$$3\ KOCl,\ aq = 2\ KCl,\ aq + KClO_3,\ aq + 24.1\ Cal.$$

The heat evolved by the changing of the hypochlorite to chlorate is consequently considerable. In the mechanical bleaching powder apparatus this is easily observed through a rapid increase of temperature.

Attention is further called to the fact that a relatively thick layer of lime on the bottom of bleach chambers may very well be chlorinated too much in the upper part of the layer, while the chlorination in the lower part is incomplete. According to Scheurer-Kastener, it is even a rule that the upper lime layers in a bleach chamber contain less available chlorine than do the others.

From what is written above we may conclude that in order to obtain the optimum results in the bleaching powder production, the following precautions ought to be taken:

1. During the first stages in the bleaching powder process, when we still have lime in excess, the reaction is favored by increase of temperature.

2. As the chlorination of the lime nears completion, it is of great importance that the temperature is lowered. If we want to produce a bleaching powder containing a percentage of chlorine as high as possible, an effective cooling is necessary to decrease the risk for formation of chlorates.

3. A steady stirring of the lime to prevent the superheating and superchlorination of the upper layers makes it possible to obtain a bleaching powder with a special high content of available chlorine.

4. Organic substances which react with chlorine or bleaching powder giving off much heat, have to be kept away.

5. Temperature of more than 60 deg. Cels. ought to be avoided even in the preliminary stages of the chlorination.

6. The presence of mechanically-bound chlorine in the finished bleaching powder ought to be prevented.

Returning to the Backman mechanical bleaching powder apparatus, it is obvious that this is the ideal mechanical apparatus for realizing the above outlined theoretical conditions for obtaining an optimum result. The process of chlorination is divided into several steps, one for each intermediate floor in the apparatus. Whereas no artificial cooling is necessitated in the upper intermediate floor, the cooling is increased in the lower ones in the same proportion as the chlorination is completed. The steady stirring of the artificially-cooled floors and the falling of the lime from floor to floor prevent local superheating and superchlorination. The course of the process may easily be controlled through the windows in each floor where thermometers are inserted. Mechanically-bound chlorine in the finished product is avoided by introducing the chlorine gas in the second floor, counted from below, and by the introduction of a small quantity of dry air in the collection silo. By stirring the bleaching powder on the lower floor, the major part of the mechanically-bound chlorine gas is forced away. This fact is of importance to decrease the disagreeable conditions for the workers filling the casks. Otherwise, especially if a shaking device is employed, much chlorine gas is wasted when packing the product.

On account of the exact temperature regulation and the steady slow stirring of the lime it is possible with the Backman apparatus to obtain an exceptionally even quality of the product and a higher content of available chlorine than is possible with ordinary lead chambers. In practice I have noticed that when ordinary lead chambers were unable to obtain a higher average content than 32 to 34 per cent and a maximum of 36 per cent, the average content obtained in the Backman chamber was 36 to 38 per cent with a maximum of 40 per cent. The same relatively bad lime was used in both cases.

It is obvious that such complete chlorination of the lime is of the greatest economic importance. The higher the content of chlorine in the bleaching powder, the lower the relative cost.

The amount of air being introduced into the chambers possesses a certain influence upon the bleaching powder process. This influence is however considerably less than in the Hasenclever and the Rudge apparatus, as the cooling chiefly is effected with water. It has thus been possible to work the Backman chambers with a chlorine gas containing only 10 per cent chlorine as well as with a gas containing 95 per cent chlorine.

The most favorable amount of air which ought to be introduced depends upon how much chlorine may be allowed in the waste gases and upon the temperature of the surrounding atmosphere and the cooling medium.

At the Backman plants being constructed up to this day, the waste gases are exhausted directly into air. The standard capacity of the chambers are from 2½ to 3½ tons bleaching powder per 24 hours. At this capacity it has been shown that when employing at least a 60 per cent chlorine gas mixture the chlorine smell of the waste gases is negligible. If more air is introduced either a somewhat less production is obtained or absorption towers have to be placed after the chambers.

In order to keep an exact control of the loss of the waste gases in Bohus, the exit of the waste gases is placed near one of the balconies. By the aid of a bottle of ammonia, it is easy to control the operation so that the chlorine content as a rule is practically zero. As a curiosity it might be mentioned that in Bohus some swallows have built a nest less than 2 feet from the exit of the waste gases.

That the absorption of the chlorine becomes so complete is explained through the fact, that the upper intermediate floors act as dust chambers when the lime is falling from floor to floor.

In cold weather the optimum production is obtained with a high concentration of chlorine gas. During the summer, the capacity is somewhat less than in the winter. In order to obtain the maximum production during the summer time it is advisable to dilute the gas to a certain extent.

During the winter it is not necessary, at least in Scandinavia, to employ any artificial cooling. On one occasion, when the gas was 10 to 15 per cent chlorine and the temperature of the atmosphere was —15 to —25 deg. Cels., it was impossible to get a product containing more than 30 to 32 per cent chlorine. By increasing the concentration of chlorine gas to 30 per cent a product containing 35 to 37 per cent chlorine was easy to obtain even with the mentioned low temperature. When it is necessary to employ a weak gas in cold weather, the Backman chambers possess the possibility of using hot water to circulate through the pipe spirals imbedded in the intermediate floors.

At one of the plants a cooling machine is being installed in order to insure special strong cooling in the lower floors. The author has not been in the position to study the results, but the capacity of the chambers may most probably be increased through this machine. At the other plants common river water only is employed for the cooling.

The desirable introduction of air may be in order to increase the production in hot weather besides serving as a regulator of temperature. Another reason for the introduction of air may be to lower the risk for explosions when a gas mixture containing hydrogen is used. Hydrogen is almost always contained in the gas from mercury cells. In such a case it might be favorable to introduce the air in the second or third floor counted from the top. The bleaching powder process is then not as much affected as the hydrogen gas is removed with the waste gases. It has in fact been shown that the hydrogen accumulates in the upper part of the chambers.

It is of great importance that the introduced air is dry, and further, that no moist air in any great quantity is sucked into the chambers in the lower floors. The finished bleaching powder is very hygroscopic and cakes together on the floors and on the scrapers when an excess of moisture is present.

Control of Moisture Important

The moisture in the lime and the gas plays an important role. Usually it is stated that an excess of water of 4 per cent calculated on the weight of the hydrated lime gives the best results and that this moisture ought to be introduced with the lime and not with the gas in order to be able to exercise an effective control. This figure is given by Lunge. We have, however, to remember that in this case, as well as in his investigations of the optimum temperature previously mentioned, he has based his data on laboratory experiments and that these are an average for the whole process. As the process is divided into several steps, the conditions in the Backman chambers and in industry as a whole are not the same. We have to take into consideration the evaporation, the condensation and difficulties through the caking of the bleaching powder. Some state to have obtained the very best results with dry chlorine gas and approximately 7 per cent excess moisture in the lime, while others claim to have a gas saturated with moisture and only approximately 1 per cent excess of moisture in the lime. In each case we might say that it is important that the moisture content is as uniform as possible in the lime as well as in the gas. The slaked lime ought to be stored in large silos for about a week and to be thoroughly mixed in order to even out any differences in the quality.

According to Ditz [*Zeit. angew. Chem.*, Vol. 14, p. 3, 25, 49, 105 (1901)], a higher content of chlorine than usual, above 40 per cent, is obtained if water is introduced during the last stage of chlorination. If this is the case, it might be easy to apply the theory to the Backman apparatus.

Regulating the Chambers

The amounts of chlorine and lime have to stand in a fixed proportion to each other in order to obtain an even quality of the product and a high chlorine content. We have here the possibility of regulating two factors: either the gas or the lime. As a change in the amount of incoming gas influences the product only slowly on account of the large quantities of gas, which are stored in the different floors in the chambers, the regulation ought to be performed through change in the amount of incoming lime and the speed of the rotating scraper arms.

Simplest and most accurate is the regulating of the chambers of course, when the chlorine feed is constant. This may be arranged through a separate chlorine tube from a fixed number of cells loaded with a constant current strength. When first having obtained the right reeding regulation the chambers are working quite automatically with the exception of some minor daily adjustments.

At a plant working with an automatic regulation of energy in order to keep a constant power consumption for the whole plant, it was necessary to take into account a varying current at the electrolytic cells. In this case an electrical connection between the driving motors in the bleach powder chamber and the generators was arranged, thus causing the number of revolutions of the motors to become proportional with the current flowing through the cells and thus even with the amount of chlorine gas being fed into the chambers. The working of the chambers was in this case made entirely automatic. The necessary minor daily regulations was made independent of the automatic regulation through a common shunt resistance.

At larger plants it is usually too expensive and complicated to have a separate chlorine tube, a separate exhauster and a separate drying tower for each chamber. In such cases, it is usual to employ a common chlorine tube with branches at the chambers. The feeding of the chlorine gas is in each branch regulated through a separate valve and controlled through a rotating flow meter.

In the windows in each floor a thermometer is placed reaching approximately 10 in. into the chamber. Every other hour the readings of the gas temperature are taken for each floor. The temperature readings are re-

corded in the reports of the operating engineer. From this temperature may be seen on what floor the chief reaction takes place, usually the third or fourth floor, if the zone of reaction moves upward or downward on account of a too slow or a too rapid feeding and if eventual superchlorination and if formation of chlorates have taken place. The influence of the temperature of the atmosphere must always be taken into consideration.

The temperature readings are, however, not an exact indication of the results. It is naturally also necessary to control the chlorine content of the bleaching powder through analysis. As a rule it is sufficient to make 2 analyses in each chamber every 24 hours. As a certain amount of bleaching powder is always stored in the collection silo, a sample taken through the opening of the silo does not always show the actual instantaneous product of the chambers. As previously mentioned, the bleaching powder is not taken out of the chambers during the night. A sample being taken in the morning refers therefore to a bleaching powder produced at least 16 hours in advance. In order to prevent this difficulty, samples are taken through the window in the lower floor. The sample thus taken consists of bleaching powder falling from the second to the first floor. From this sample the content of available chlorine in the finished product is usually approximately 1 per cent higher than in the sample taking as above described. If the excess of the chloride-chlorine is more than 3 per cent, this shows that the formation of chlorate is beginning to take place.

A sample is usually taken out each morning and each afternoon. According to the analysis the speed of the scraper arms is adjusted. In the time between these two adjustments the chambers do not need any other control than the inspection of the foreman each second hour.

The work required for the operation of the chambers might be summed up as follows:

1. The silos are emptied and the bleaching powder is packed into the casks. The number of workers required for this work depends upon the number of chambers. These workers have nothing else to do with the operation of the chambers.

2. The necessary amount of lime is conveyed to the lime silo on the top of the chambers. The workers in the lime-slaking house have charge of this work.

3. The laboratory makes an analysis each morning and each afternoon.

4. According to this analysis the foreman regulates twice a day the speed of the driving machinery. The foreman further takes the readings of the temperatures in the chamber every other hour and makes sure that the feed and the fans are working properly.

If the analysis and the temperature reading show that a superchlorination or a chlorate formation has taken place the driving machinery is for some hours speeded up and the highest speed is maintained until normal conditions are obtained. If a good lime is employed such disturbances do not often occur when the foreman is familiar with the working of the chamber.

The table below shows the conditions in a chamber. The investigation was made on May 27, 1925. The temperature of the atmosphere was 20 deg.C. The incoming gas analysed 80 per cent Cl_2, 2.15 per cent CO_2 (calculated on the chlorine 2.7 per cent CO_2).

The chamber was in this case fed with gas from only 25 electrolytic cells each loaded with approximately 1,000 amp., corresponding to a production of approximately 1.7 tons bleaching powder per 24 hours. From the table we may see, that it is chiefly floor Nos. 1, 2, 3 and 4 in which the reactions take place. The main reaction takes place in floor Nos. 2 and 3. The temperatures show that the gas in the lower floor has been cooled down to the temperature of the atmosphere.

At higher loads and during warm days, the temperature in floor Nos. 3 and 4 may increase to 50 deg. Cels. without any danger.

The above trial was made at a time when the carbon dioxide content was exceedingly high, 2.7 per cent CO, calculated on 100 per cent chlorine mixture. In spite of this fact, any difficulties were not met with obtaining a first-class product.

P.M.	Number of Floors Counted from Below	Gas, Per Cent Cl_2	Bleaching Powder, Per Cent Cl_2	Temperature, Deg. C.
4.25	Floor 1	42.9	37.0	20
4.35	Floor 2	40.5	34.5	21
5.30	Floor 3	1.54	10.0	33
5.45	Floor 4	1.38	5.0	34
7.15	Floor 5	0.05	1.5	20
7.30	Floor 6	0.04	0.4	21
....	Floor 7	.....	....	..
8.00	Waste gases	0.02	....	..

When comparing other bleaching powder processes, the Backman chamber possesses the following advantages:

1. The labor costs are the lowest possible because labor is only employed for the filling of casks, and this is made in the easiest way possible from a silo.

2. Extra compensation to the workers is eliminated as there is no chlorine in the surrounding district. Absorption towers for the waste gases are not necessary.

3. The number of necessary control analyses is small, and the supervision of the whole plant and the working of same is only slight.

4. The chambers are normally working at least 3 or 4 months without any interruptions and without having to open them. (Compare this with the daily cleaning in the Hasenclever apparatus.)

5. The cost of repairs is limited to the change of scrapers in the lower floors, at most twice a year, and inspection of the inner protecting coating at most once a year. For repairs and inspections all the inner parts are easy to reach.

6. The power consumption is only 0.2 to 0.3 kw. per chamber of 2.5 to 3 tons capacity.

7. It may be employed with a high as well as a low concentration of chlorine gas. The difficulties from carbon dioxide gas are considered less than in the ordinary lead chambers.

8. The gas volume in the chambers is relatively great, so that any fluctuations in the amount of gas are evened out. This is of importance when for example working with waste gases from a plant producing liquid chlorine or chlorine products.

9. Through the steady stirring and the excellent cooling of the finished bleaching powder, a uniformly high concentration and well-keeping product is made possible.

10. The space required is less than with any other method.

11. The capital costs are low. These are considerably less than for lead chambers, and even less than the costs for other mechanical bleaching powder apparatus, when taking into account the fact that these require special buildings.

Working Corrosion-Resistant Metals

Experience shows details of design to be of great importance in life of equipment in severe service

By W. S. Calcott
Jackson Laboratory, E. I. du Pont de Nemours & Co.

IN the construction of plant equipment that is required to resist corrosion, the methods of working and fastening metals play an important part in service, especially when aqueous solutions are concerned. Any general statements are, of course, subject to numerous exceptions; but certain broad considerations, while doubtless frequently introducing errors, will at least lead to errors on the safe side.

In a general way, methods of working or fastening metals should be such that when the equipment is in use, electrolytic action is not induced unless the electronegative metal is protected in some manner from the corrosive liquid. The importance of this effect depends, of course, on the actual magnitude of the rate of corrosion. If this is small enough, as for instance, a caustic solution in iron, welded joints, riveted joints, etc., can be employed safely, or steel fittings with cast-iron tanks. In dehydrating caustic in cast-iron pots, however, it has been noted that a steel thermometer well, inserted in the usual way in metallic contact with the pot, had a life of only 36 hr. Insulating the well from the pot increased its life enormously, showing that the effect was electrolytic, as was also indicated by measurements between the pot and well. On account of the difficulty of maintaining the insulation, wells of a different material were selected, but the results were of interest as illustrating the effect of electrolysis even under these conditions.

One of the most striking illustrations of the magnifying effect of small potential differences on corrosion rates under certain conditions was in the construction of a nickel thermometer well for a small piece of equipment. The liquid to be handled was strongly acid and also hot. In the first installation, due to an oversight, the nickel pipe and sheet nickel flange were not annealed after machining. Rapid localized corrosion occurred at the junction between flange and pipe, in distinct contradiction to the laboratory results. The assembled well was then annealed carefully and returned to service, upon which the laboratory test of a relatively low corrosion rate was verified. Apparently the cold working of the metal had sufficed to set up a potential difference of more than negligible proportions.

A number of experiences of this type have led, in the experimental work at least, to the standardizing of a type of construction in which, as far as possible, the stray current effects are minimized. The principle involved is simply to keep the entire equipment homogeneous. When extremely corrosive liquids are handled in metals, the metals selected are usually lead, a copper alloy, a nickel alloy, or, more rarely, iron-silicon, "stainless steel," or aluminium. In all cases such methods of fastening as soldering and, ordinarily, brazing, are ruled out, as the joint then becomes a constant source of trouble, either due to failure of the seam itself, or to stimulated corrosion of the metal adjacent to the seam. When the conditions are very severe, riveting or even bolting is not permissible, and the only corrosion-resistant method of construction is casting. The sensitivity to stimulation by small potential differences in some instances can hardly be overrated. Welding is another method of working that has been a fertile source of trouble due, probably, to the inclusion of oxide or carbon in the weld, setting up troublesome stray currents. For this reason casting seems to be the safest method of working metal that is subject to strenuous service, whenever this method can be employed, since the highest degree of homogeneity can usually be obtained. Welding, if carefully done, with the exclusion of foreign matter from the seam, is quite resistant, especially if annealed, and mechanical working and fastening, if annealed, are also satisfactory; but soldering and brazing are likely to lead to trouble. In one interesting example in which tubes brazed along a longitudinal seam were used, the tubes quickly opened along the seam. Thinking to remedy this weakness by using a more resistant solder, the tubes were rewelded with silver solder, which was itself entirely insoluble. After a few weeks the metal of the tubes, with the exception of the silver soldered seam, was extensively perforated, the seam itself remaining almost unattacked.

Confirming Laboratory Tests

When the corrosive solution is not an electrolyte, these objections to the use of dissimilar metals obviously do not apply, and combinations as unlike as brass and iron can be safely used under such conditions. It is due possibly to such anomalies as this, and to the difficulties introduced by the stray currents caused by such apparently small differences in metals as can be caused by cold working to the extent of threading, that laboratory tests are sometimes held in disfavor. At this laboratory, after tracing down the cases in which the plant or semi-works did not check the laboratory tests, after allowance has been made for such factors as potential differences between different metals or different parts of the same metal, velocity effects, erosion, oxidation, and variations in the composition of the solution actually used and that sent for test, there have been but few cases in which the final result has not been found to agree closely with that predicted, so that the operating men have developed considerable confidence in the statements of the laboratory as regards the most suitable metals for a given set of conditions.

Making Gaskets Leak-Proof

A minor item, that has at times given some trouble, has been in the use of gaskets. Frequently these are made wide enough to allow a safe margin after the bolt holes are cut, and when installed are thus practically the full width of the flange. If any liquid leaks along the gasket as far as the bolts, trouble is almost certain to result. Even when the bolt is of the same material as the vessel, which is presumably capable of resisting corrosion satisfactorily, the highly strained condition of the bolt is likely to cause trouble. If, instead of this construction, a narrow gasket is installed inside the bolt circle, any leakage that reaches as far as the bolts themselves becomes obvious immediately, and can be remedied before any damage is done.

Paper read in the corrosion symposium at the 18th semi-annual meeting of the American Institute of Chemical Engineers, Berlin, N. H., June 21-24, 1926.

Predetermining Profits

Procedure for forecasting the financial prospects of a new line of manufacture

By E. Yeakle Wolford
Norristown, Pa.

DESPITE continual changes in trade practices, the immutable aim of business is to operate at a profit; in fact, this is its sole reason for existence. No matter how altruistic or paternalistic a company may be, profits are the life blood of its existence. They may be distributed solely to the owners or stockholders, or they may be shared to the benefit of the employees, but without them business, including non-profit organizations, soon ceases. Thus, we may say, to paraphrase, on the profits hangs all the law.

The science most directly concerned with profits is accounting and until recent times accounting has had a backward looking view. In other words, the accountant has been chiefly concerned in the financial aspects of past performance, in preparing statements of an organization's financial position and of its earning capacity over a certain previous period. More recently, the practice of estimating costs has given accounting a new branch, in which the aspect is a forward looking one, based upon a knowledge of past performance. Among the latest developments in accounting, all of which aim to give exact, detailed information, upon which executives may base decisions, is predetermining the probable profits from the large scale manufacture of a new product. Here the aspect is forward looking but with practically no past performance that can be made to serve as a guide.

Chemical Engineers Concerned

The chemical engineer and, especially, the research chemist have frequently been charged with disinterest in business requirements and lack of business ability. This often justified condemnation means simply that men with chemical training do not keep their eye on the ball of business—profit. They are too busy keeping an eye on that fascinating, jealous mistress, chemistry. But should they be thus too busy?

Another condemnation of men with chemical training is that such men cannot talk other than over the heads of business men. However, this fault lies partly in the lack of interest by business men in the general topic. Let a chemist or engineer talk about profits and the business men prick up their ears, not so much because the discussion is couched in their natural vocabulary, as because the subject is one of basic interest to them. Respect will soon replace derision and both co-operation and appreciation will increase where the chemist talks business; as illustrated by the growing number of chemists who have become executives simply by being able to see both the equation of the reaction with its calories given off or absorbed (usually omitted), and the equation of business with its profit dollars given off or absorbed (the latter usually omitted due to bankruptcy).

As many firms have found that it is easier to train chemists in selling than to train salesmen in chemistry, so chemists and engineers can learn to use the principles of accounting more easily than accountants can learn to use the principles of chemistry. For accounting is applied common sense, where chemistry, like medicine and psychology, is the attempted classification of the infinite variations of Nature. It seems reasonable to suppose that by virtue of his scientific training, the chemist should be able to apply the cold logic of accounting easier than the accountant might be able to evolve those hunches upon which chemical progress so largely depends. An accountant may go into a foundry or machine shop and easily grasp the ideas of the work, so that he can estimate the costs of various jobs and then set the selling prices, or he may even determine on just what lines the business should be developed; but for an accountant to look over the plans and processes of a proposed chemical plant, and predict the possibilities of the development as a profitable enterprise, is unusual. Here is a job in accounting for the development engineer or chemist, which, while no doubt often well done, as many successful developments prove, has too often been neglected, as glutted markets, idle plants and proceedings in bankruptcy show.

What Must Be Considered

The situation to be considered, although invariably differing in details, may generally be described as follows:

1. Someone in the organization has realized that a business opportunity lies in producing a certain chemical, either because a new use of the substance has been discovered or because the known uses are increasing in volume. Or the business opportunity may lie in a newly discovered substance, for which there is an obvious demand. Of the two possibilities the latter is the more difficult to handle.

2. The research department has found a maximum yield process for making the chemical and the details of the most profound influences on the process.

3. Adequate semi-plant experiments have been carried out, which give the vital engineering details for plant construction, such as materials and corrosion of apparatus, routing, timing of steps, storage facilities required, etc., etc.

4. A rough determination of the per pound or per 1,000 pound direct cost of the chemical has been made. This subject, along with cost methods for various other phases of chemical activity, has been outlined by Weiss and Downs ("The Technical Organization," McGraw-Hill Co., Inc., New York, 1924, pp. 170-174). As consideration of indirect charges due to overhead, capital expense, sales expense, etc., are naturally omitted, it may be remarked that the direct cost is the mere beginning of expense.

5. The problem now confronting the research chemist,

the development engineer and the executive, usually the production manager, jointly, is to design a plant for large scale production. It may be thought that the problem is that of the development engineer alone, but that the problem is a joint one, which must be solved by all three, will be shown later.

6. The ultimate joint problem, concerning the profitable nature of the operation of such a plant, is just appearing. It is possible, as will be shown later, and of course desirable, to solve this problem while the plant is still on paper, at which stage the only investment is the cost of the laboratory and the semi-plant research, mentioned above.

Procedure to Be Followed

The attack on the problems resolves itself first into correctly answering two questions. The first question is simply: "For what price per pound can the chemical be sold?" The lower limit to selling price is obviously shown by the direct cost, already found, yet of course the actual selling price must be well above this figure, in order to provide a margin for the innumerable indirect expenses which will be met. The upper limit of selling price, if the chemical is a new one, can generally be determined by an executive, who has sound business judgment and ample information on the various economic features to be considered. Somewhere between the two figures is the logical selling price, which is not so high as to be prohibitive, thus seriously reducing volume of sales, while yielding a fair profit by high per pound profit, nor so low that fair profit depends on large sales volume, which constantly strains the production units. In case the chemical is already on the market, where the reason for production is growing demand, the selling price is already established, and profits depend largely on economies and improvements in plant and process. In either case, it is well to be prepared for a drop in the market price after production is put on a tonnage basis.

The Question of Capacity

The second question to be answered is: "What should be the production capacity of the plant?" Naturally, the plant should not be so large that the market would be glutted by a normal output. Such plants are prone to the industrial disease called idle capacity, which is now receiving much serious consideration by both accountants and executives. Nor, neglecting the possibility of quickly adding further units, should the plant be so small that on development of a popular demand, orders could not be filled within a reasonably short time. Such a situation is always embarrassing and such a plant is little better than an experimental small scale one, for the producer risks losing the first rush of orders, which usually greets an article that fills a long felt need. Aided by sound business judgment and intimate information on the economic situation or trend, the wide-awake executive can usually answer the capacity question; in fact, he has usually decided upon a certain capacity earlier in the development.

However, since production units alone do not constitute an organization, the capacity question must be answered with a view to the effect upon other arms of the organization. The particular arm most affected is the sales force. Thus the actual mechanics of distributing a new product, which generally requires considerable missionary work on the part of the sales force, although judicious advertising is of assistance, may require an expansion of the sales and office force and facilities. It may be said in passing, that such expansion is, of course, to be charged as indirect expense to the new product as will be shown later.

One further phase of the general situation still complicates the answer to the capacity question. Profitable operation is seldom possible except on a sizable basis, yet it is often found that at a certain annual capacity no profit can be made, whereas at double the capacity the profits are reasonable. Altogether, the factors effecting capacity are so numerous that the best judgment of an executive is required. Unfortunately, these almost obvious points in connection with plant development are too frequently neglected, even though their consideration at this stage is of great importance. Such neglect arises simply from a lack of co-operation between the technical and executive branches and men with so little foresight deserve no more sympathy than does the man who built his plant and then woke up to find that his patents were largely infringements of the patents of others.

Where Accounting Comes In

It must be admitted that the questions throw a heavy burden upon the executive's business judgment. Fortunately, accounting is rapidly coming to the rescue by developing means whereby the executive may be provided with accurate information upon which he can rest his decisions. One particularly pertinent aid is the recently developed method for measuring the amount of net profit in sales volume for different products. This is simply a determination of the amount of profit, which each dollar of gross income must yield in order to provide for indirect costs and a minimum net profit. For instance, certain lines have been found to be profitable when only one cent of each dollar is profit, where other lines may require a profit of twenty cents of each dollar to provide a six per cent profit and six per cent for reinvestment in plant expansion. The difference is chiefly a result of burdens such as large equipment investment and large idle capacity or idle time of the whole capacity. If the executive has access to such figures on a similar product, his judgment can be considerably augmented by applying the net profit in sales volume ratio of the known product to the product which is to be made.

Method of Determining Profits

When the correct capacity for the plant has been determined, the development engineer proceeds to apply the semi-plant data to designing a plant. The design, covering character, size and layout of apparatus is interpreted by a flow sheet of material, which shows the quantities at any point at any time, and the length of time required for a given batch of raw material to travel through the plant and become finished product. Next, the labor and superintendence of labor are considered and the number of operators, as well as the duties of each man, is estimated. If all these points cannot be decided, the semi-plant data are insufficient. They should be expanded and only when all the points can be decided, can the possibilities of profit be predetermined; hence, predetermination of profits, while the plant is still on paper, is a strict criterion of the sufficiency of semi-plant data.

In predetermining the profits, the gross income of the

plant is found by combining the answers to the price question and the capacity question; the value of any by-products is to be added. Next every expenditure, which must be met from gross income, is tabulated and estimated on an annual basis. (An example of such a tabulation will be found in *Industrial and Engineering Chemistry*, News Edition, vol. 3, No. 22, Nov. 20, 1925, page 2). Material and direct labor costs can be found directly from the semi-plant data, as well as can the cost of such facilities as steam, power, light, repairs and replacements, etc. Administration, selling and advertising costs can usually be determined by various accounting schemes from similar costs known to the executive. Invested capital (on which there is usually a carrying charge) including cost of land, buildings, materials in process and in stock, etc., can be accurately determined from the plant design and semi-plant data. Certain appropriations must, of course, be made for control and research laboratories, as well as for taxes and insurance.

What Predetermined Profit Is

The total of expenses is subtracted from the gross income and the answer is the possible profit. If proper judgment has been exercised on the economic possibilities of the product, and if the semi-plant results have been adequate and have been interpreted with accuracy, the predetermined profit should be very reliable. This figure, however, does not represent the profit from the operations of the first year, for the estimate may be too great as a result of organization or engineering difficulties or it may be too little because of process or plant improvements, none of which can be foreseen. The figure really applies to one representative year during which normal operating conditions prevail. The object of predetermining profits, as has been said, is simply to see whether they will be large enough to justify erecting a plant, before any great expenditure has been incurred. The predetermination is based upon a simple assumption that the semi-plant data show just how the plant will run, before it is built. If the semi-plant data do not show this, they are inadequate and need elaboration.

Profits Must Pay For Investment

Obviously, no one would build a plant which could not be operated at a profit of 10 per cent or even 20 per cent. An important point is that the profits from the plant must pay for the investment in the plant. And considering the rapidity with which equipment becomes obsolete under present technical advances, many manufacturers hesitate to go into a project where the profits will not pay for both plant and equipment in six months to a year, the time naturally depending on the nature of the product. Where the predicted profits are zero, the possibility of increasing capacity should be considered, for gross cost per pound usually decreases with increasing capacity, leaving a greater margin of profit. If, however, it appears impossible to distribute a greater production, the project should be dropped on the grounds that the economic situation is not ripe for it. Again, where the profits are zero or as is more often the case, appear to be small, the fault may lie in the process, which must either be brought to a higher state of perfection, or be discarded in favor of a cheaper or more efficient one, should it still seem desirable to continue the project.

An example of the reliability of such predetermined profits has come to the attention of the writer. It seemed desirable to produce a certain chemical because the source of supply was in great part foreign. At a production of 40 per cent of the American consumption, the direct cost estimate seemed to predict an annual profit of $10,000 on an investment of $50,000, which investment included plant and working capital. When the profits were predetermined as described with all expenditures included, the annual possibility under the most favorable conditions was found to be only $1,500. Moreover the large volume presented notable distribution difficulties. Hence, the project was immediately pigeon-holed, after only a nominal sum had been spent on laboratory and semi-plant research. The correctness of the decision was proved six months later when the largest American producer went into receiver's hands. Foreign producers halved the market price within a year. Thus it will be seen that predetermining profits prevents the investment of large sums in ventures which are inherently doomed to failure.

Doubtlessly, this very system of predetermining profits has long been practiced in successful, growing plants. It can be seen that there is no great mystery about the matter. It has one particularly happy by-product, interdepartmental co-operation, the most elusive phase of plant morale. With the research chemist, the development engineer and the production manager, or other executive, working together thus, there is certain to be developed that mutual respect and amicability, that spirit of co-operation and striving toward a common goal which gives an organization true *esprit de corps*.

Graphite Production in 1925

The Department of Commerce announces that according to data collected at the biennial census of manufactures, 1925, the establishments engaged primarily in the grinding and refining of graphite reported a total output valued at $2,569,487, an increase of 17.6 per cent as compared with 1923, the last preceding census year.

Of the 11 establishments reporting for 1925, 3 are located in Pennsylvania and the remainder in California, Illinois, Michigan, New Jersey, New York, Ohio, and Texas.

The statistics for 1925 and 1923 are summarized in the following statement. The figures for 1925 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

Graphite Production in the United States—1923 and 1925 Statistics Compared

	1925	1923	Per Cent of Increase or Decrease (—)
Number of establishments	11	8	(a)
Wage earners (average number) *b*	228	244	—6.6
Maximum month	Mar. 237	Feb. 269	....
Minimum month	Dec. 216	Jan. 229	....
Per cent of maximum	91.1	85.1	....
Wages	$278,224	$304,437	—8.6
Cost of materials (including fuel, mill supplies, and containers)	$1,328,188	$1,082,018	22.7
Products, total value	$2,569,487	$2,184,509	17.6
Value added by manufacture *c*	$1,241,299	$1,102,591	12.6
Primary horsepower	2,927	2,700	8.4

a Per cent not computed where base is less than 100.
b Not including salaried employees.
c Value of products less cost of materials.

Modern Floor Covering Plant Uses Electrical Control

Description of the process, drive and control used in one of the most modern plants manufacturing this class of goods

By William Clark and E. A. Hancock

General Electric Co., Schenectady, N. Y.

WHILE George Washington was our President, another George, surnamed Bird, built and equipped a small mill for the manufacture of paper, on the banks of the Neponset River at East Walpole, Mass.

Starting with a very small capacity, the output of this mill was increased until in 1877 it was 20 tons per day. Last year (1925), the entire plant, consisting of box, special paper, floor-covering, building, and roofing divisions, controlled by Charles Sumner Bird and under the name of Bird & Son, Inc., handled over 2,000 tons per day.

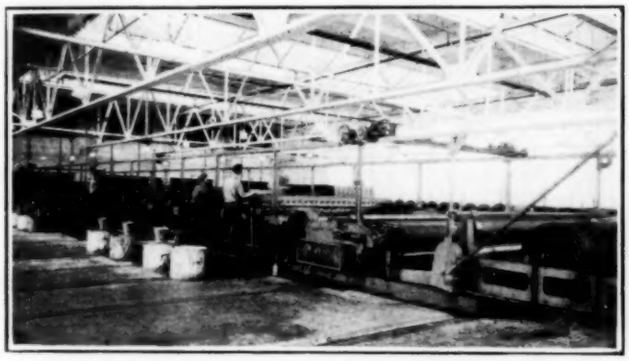


Fig. 1—General View in Printing Machine Room
The picture shows the type of construction used giving an unobstructed working space and ample light. Note the electric control on the side of the printing machine.

The quality of construction in the new floor-covering plant is unique. The machine room, which is all brick and steel construction, has a clear unsupported space, 105 ft. x 133 ft., and the ovens are of a new type of fireproof construction.

Complete new units have also been built for the paint-manufacturing and oil-boiling sections. With the new paint-making equipment, this concern is now the largest manufacturer of this product in New England, although it produces solely for its own use.

Fig. 1 shows quite clearly the construction of roof, supports, the lighting, both natural and artificial, and the printing machine. At the right is the roll of felt (a heavy, waterproof paper) upon which the desired design is to be printed. The felt passes through metal rolls across a short open space, thence to the bed of the printing-press section of the machine. As the felt enters this section vertically, projecting metal spurs on endless steel belts on each side of the machine are forced through the edge of the felt. These belts carry the felt through in 18-in. steps, mantaining perfect alignment in order that proper register of the color design may be obtained.

The required design is hand-carved on wooden blocks. These blocks are mounted in heavy metal forms and are supported above the felt. The man at the right in Fig. 1 has his hand on one of these forms.

As the felt makes its 18-in. movement through the machine, the blocks are raised and "inked" with high-grade enamel deposited by rollers moving horizontally beneath the block. When the felt stops at the printing position, the block descends, leaves its "impression" and returns to the "inking" position. There being a separate block for each color, this movement is repeated by succeeding blocks until the design in all its various colors is reproduced.

The main drive is very simple, consisting of a motor mounted beneath the bed of the machine, directly connected through a clutch to the driving mechanism, and controlled by a standard, hand-operated compensator mounted on the machine frame, as shown in Fig. 1. The machine is a self-contained unit from both mechanical and electrical standpoints. Electric power for all purposes is supplied through the trolley system shown in Fig. 3. Below the running board may be seen the auto-transformer for providing 110 volts for the machine-lighting system, also the bell-ringing transformer for the signal bell mounted above the running board.

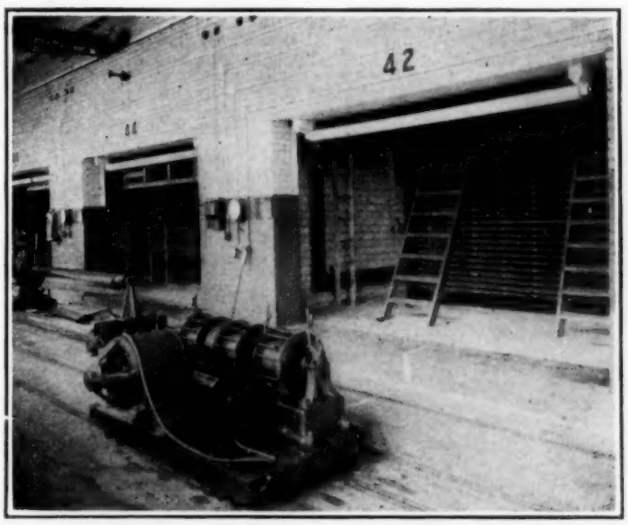


Fig. 2—Equipment for Drawing Sheets into the Drying Oven
The 3-drum winch, motor and controller are mounted on a truck on rails which permits the winch to be placed at any desired point in front of the oven

This figure also shows the block forms in their upper or "inking" position. The "inking" roll carriages are seen beneath the forms somewhat indistinctly as the machine was in operation when photographed. The cams near the running board, which raise and lower the blocks, appear as discs for the same reason.

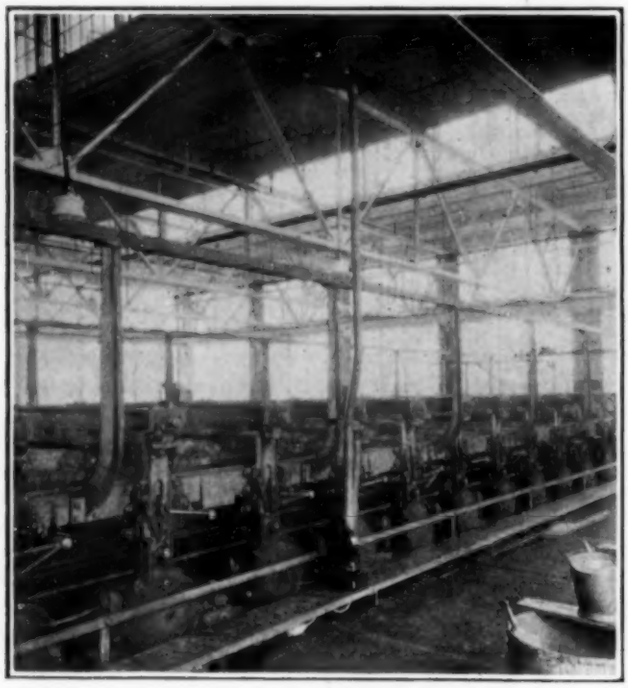


Fig. 3—Trolley System for Supplying Power to Printing Machine
This trolley supplies the current for all purposes. Below the running-board is an auto-transformer for supplying the lighting current. On the running board is a bell-ringing transformer for the signal bell

Having completed the printing operation, the felt now has a fresh enamel-coating of intricate design which must be handled with extreme care and placed in a drying oven in sheets approximately 180 feet long. The equipment for drawing these sheets into the drying oven consists of a three-drum winch driven by a 2-hp., 500 to 2,000 r.p.m. motor. Both winch and motor

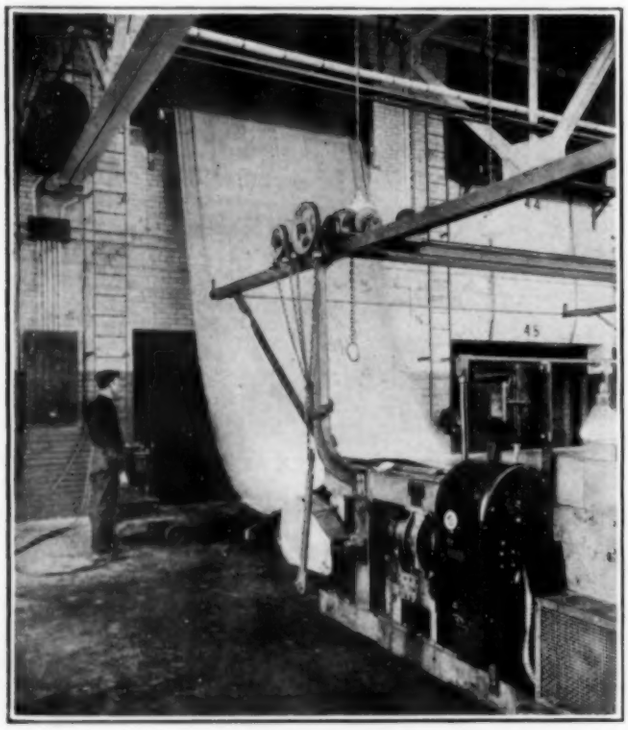


Fig. 4—Delivery End of Printing Machine
This view shows the material entering the drying oven, the method of controlling the pulling-in winch and the compensator for the machine motor

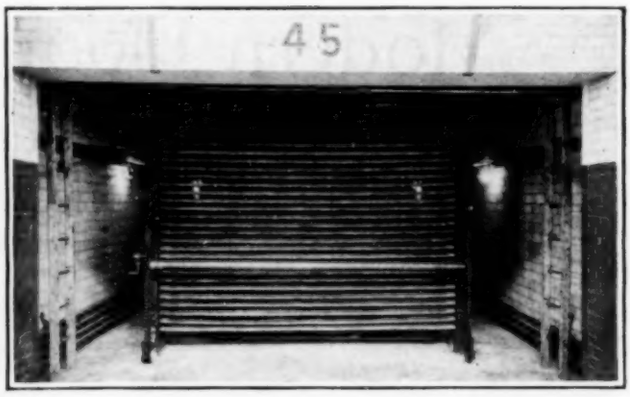


Fig. 5—Entrance of One of the Drying Ovens
Each of these ovens has a capacity of 50 sheets, 180 ft. long. The 10 ovens will take care of 5 days continuous production, the first being through its run and in process of unloading while the tenth is filled

are mounted on a truck capable of lateral motion across the oven openings, as shown in Fig. 2. The motor is provided with a flexible cable and a polarity plug for insertion in service receptacles located on the end wall between the ovens, as shown. While one drum is hauling, the cables of the idle drums are being threaded back in preparation for the following sheets. A somewhat novel control was developed to prevent upsetting the truck in case the cables or the felt sheet became caught in the drying rack. The chain, hanging from the motor service switch handle, carries a weight at its opposite end which rests upon the floor when the switch is in the closed position and the truck is horizontal. Should anything catch in the oven, then the truck tips up and this weight opens the switch, stopping the motor.

The speed at which the sheet is drawn into the oven is controlled by the man shown in Fig. 4. The control equipment consists of a drum switch with armature and field resistors all mounted on a small truck and provided with flexible cables, polarity plugs, and receptacles, duplicates of, and connected by conduit wiring to, those at the winch end of the oven.

The wide speed range of the pulling-in motor is required to haul the sheet out of the way of the men, who have cut it to the proper length, to allow clamping to the succeeding sheet and to take up the slack in the latter sheet before damage to the printed surface can occur, as the printing machine operates continuously,

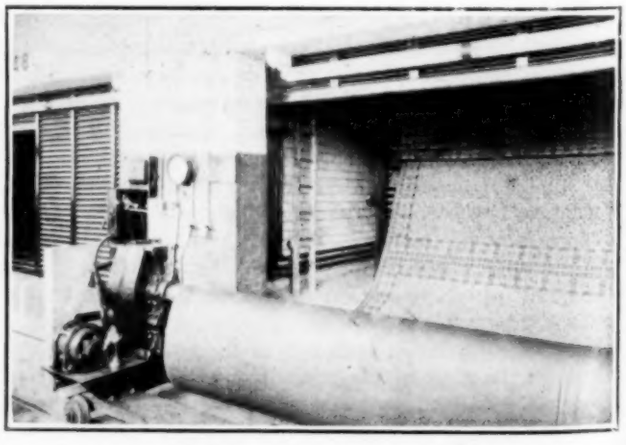


Fig. 6—View of Withdrawing Machine
This machine takes the dried sheets from the oven and rolls them. It is mounted on a track and can serve various ovens as required

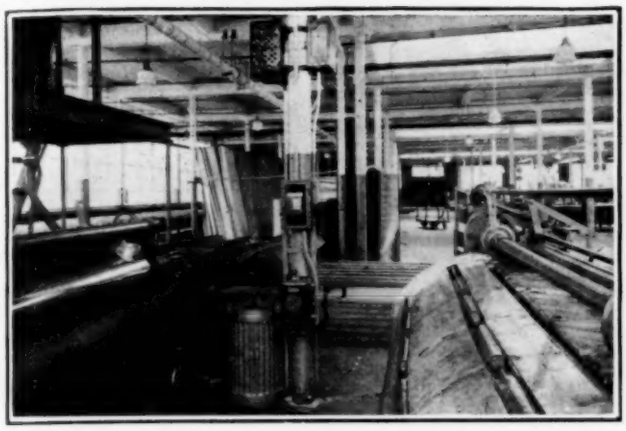


Fig. 7—Finishing Machine at Left, Trimmer at Right
The column in the center of this view shows the controllers for the 2 motors which operate these machines, the lower controller operating the adjustable motor of the finishing machine.

unless stopped for cleaning blocks or at the end of a five-day run, for which the plant is designed.

Two winches and their control are required for each printing machine: one for the upper and one for the lower row of ovens. An interesting feature of this installation is (this company operates three of these printing machines) that a total of six equipments were supplied and so designed that any one of the six controls would operate successfully with any one of the six motors.

Fig. 4 also shows the freshly printed felt leaving the machine in intermittent, 18-in. movements and entering one of the upper-row ovens. The Trumbull switch and compensator for the traverse motor, used to center the printing machine in front of the desired oven, is mounted on the frame of the machine, as shown.

The plant is so designed that the ten ovens (the entrance of one being shown in Fig. 5), each with a capacity of fifty 180-ft. sheets, will take care of a continuous 24 hour, 5 day production, the first ovens filled being perfectly dry and in the process of removal while the last ovens are being filled.

The dry sheet is withdrawn from the oven by the machine shown in Fig. 6, driven by a 2 hp., 1,800 r.p.m. motor provided with a Trumbull switch. This machine simply rolls the sheets for transfer to the finishing department. This figure also shows the Trumbull switch for motors driving oven fans, thermometer for recording oven temperature, 3-phase receptacle, plug and cable for pull-out machine, and push-button stations for signaling to the machine room the position of an incoming sheet.

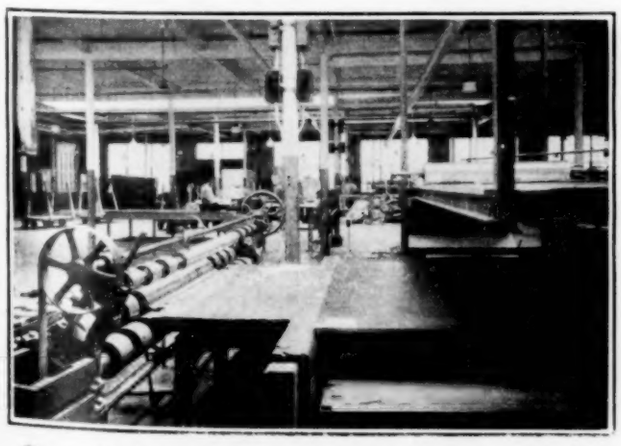


Fig. 8—Machine in Which the Rugs Are Rolled and Wrapped
The controllers for the 2 motors that drive this machine are located high up on the column in the center of the picture.

In the finishing room, the sheet passes through the machine, shown at the left in Fig. 7, which coats the back with a special wax. The sheet then loops downward and enters the edge-trimmer at the right, which is driven by a 1-hp. motor. The waxer is driven by an adjustable speed motor, it being necessary to keep the sheet in motion during the waxing process and to maintain sufficient slack between waxer and edge-trimmer to allow the wax coating to harden. The control for both of these motors may be seen mounted on the column in the center of this figure.

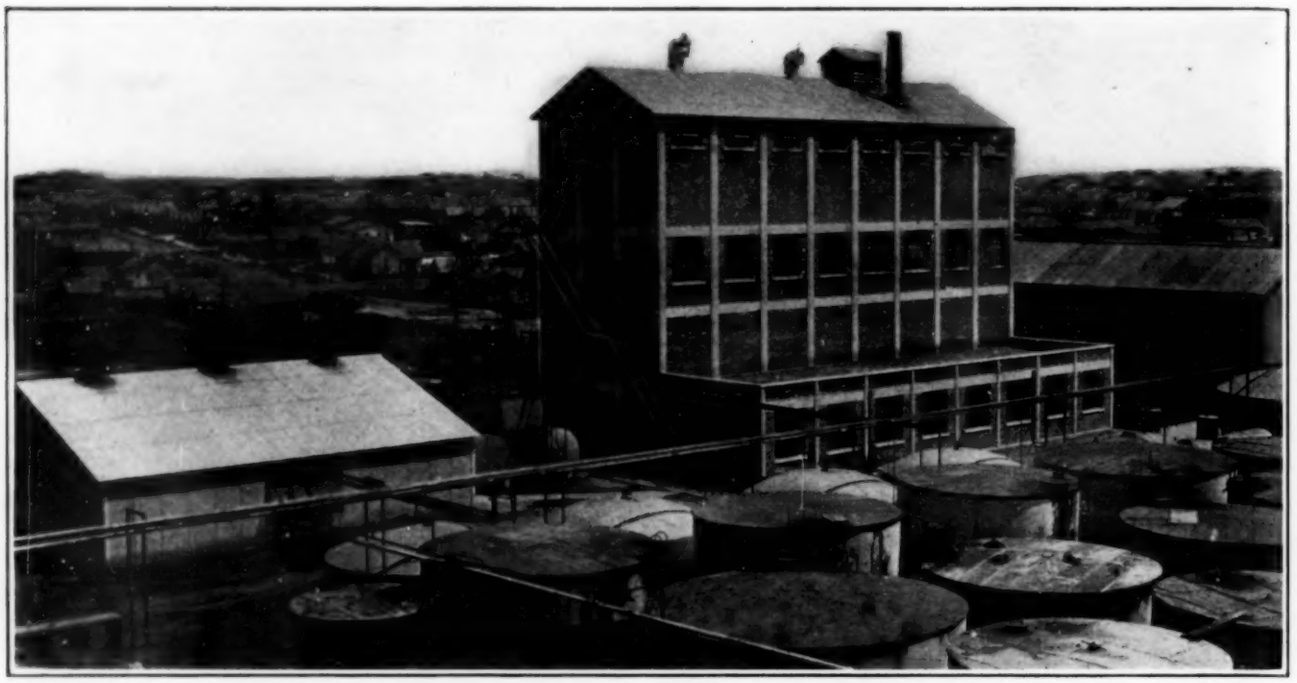
The sheets are then cut into proper size rugs by an ordinary motor-driven guillotine cutter. From the cutter, finished rugs pass to the rolling and wrapping machine, shown in Fig. 8, from which they go directly to the shipping department. This machine is driven by two motors controlled by switches mounted high on the column near the center of the picture.

New Method of Burning Lime Prevents Waste

An outstanding problem in the lime industry is the profitable utilization of the small stone, known as spalls and fines. Stone under four inches in size cannot be calcined successfully in the shaft kiln, and every day thousands of tons of such stone are either entirely wasted or are sold at prices so low as scarcely to cover the cost of production. The Bureau of Mines of the Department of Commerce, through the Nonmetallic Minerals Station at New Brunswick, N. J., has given much study to possible solutions for this waste problem. It has been found that fines are successfully calcined in the rotary kiln, and that rotary kilns are gradually being brought to a higher point of efficiency, but that rotary kilns present certain serious disadvantages. Having in view the development of equipment less costly, less cumbersome, easier to manipulate and of higher fuel efficiency than the rotary kiln, exhaustive experiments have been made with a sintering machine such as is used for roasting sulphide ores.

The sintering machine consists essentially of a series of traveling pallets with perforated floors. The pallets loaded with crushed limestone pass beneath a burner which supplies an intense heat, and over a suction box which maintains a downward draft to carry the flame through the charge. Complete calcination is attained in 30 to 60 minutes. Small scale tests were followed by more complete tests on a small-size standard commercial machine. A general average of all tests made gave a fuel ratio of 5.5 pounds of lime per pound of kerosene plus 5 per cent of coal which was mixed with the charge. This compares favorably with present commercial practice. Several important changes may be found necessary before the highest point of efficiency is attained.

The advantages claimed for the sintering machine are low first cost, low maintenance cost, fair fuel ratio, continuous operation, and ability to use small stone. The results of the investigation indicate that the machine has excellent possibilities for the production of lime from small stone, but considerable redesigning is necessary to adapt it to this use.



Filter House, Bleacher and Run-Down Tanks at Empire Refinery, Okmulgee, Okla.

Revivifying Fullers Earth in a Modern Filter Plant

Use of ore-roasting furnace marks profitable application of chemical engineering equipment in new role

COMMON interest in fundamental processes and equipment is the bond that ties together the chemical engineering group of industries. That this bond is constantly being strengthened is shown by numerous new applications of long-established methods and practices and by the growing interchange of technical information between industries. Convincing evidence of recent progress in this direction is to be found in the modern filter plant of the Empire Refineries, Inc., located at Okmulgee, Okla. In designing this plant, the Empire engineers under the direction of H. W. Camp, general superintendent, have not only incorporated the best features of standard practice but have introduced innovations that have already resulted in increased operating efficiency. One example of this advanced design is to be found in the adoption of an ore-roasting furnace of the Wedge multiple-hearth type for regenerating the fullers earth used in the lubricating oil and wax filters. This step was taken after a careful comparison of actual operating results with the rotary and other types of ovens generally used for clay regeneration.

In the new filter house, shown in Fig. 1, the principle of gravitation is used almost entirely for carrying the fullers earth through the different processes. The raw material is taken to the top of the building and gradually processed so that the finished and spent materials are removed at the ground level. Geographically the plant at Okmulgee is centrally located in respect to the principal fullers earth deposits of Florida, Georgia, Illinois and California. The selection of the fullers earth to be used, therefore, depends largely upon the service to which it is put.

The earth as received at Okmulgee is dumped out of the boxcars into a screw conveyor which carries it to the "green" earth storage bins. Before it can be used, however, it is necessary to "temper" it, i.e., to remove the hygroscopic or natural moisture and a part of the water of constitution. This drying is accomplished in a multiple-earth furnace where it is heated to about 600 to 700 deg. F.

The burner, which is shown in Fig. 2 was supplied by the Wedge furnace department of the Bethlehem Foundry & Machine Co. In general, it is of the conventional type, widely used in ore roasting, having the rotating rabble arms carrying scrapers or rabble blades that propel the fullers earth concentrically over the various hearths. The heating is done by the hot combustion gases resulting from the burning of either oil or gas in the auxiliary fire boxes shown on the opposite sides of the burner. The earth does not come in direct contact with the flame. Careful control of temperature, which is essential in maintaining high filtering efficiency in the earth is possible because each combustion gas inlet is provided with a sliding damper and the operator is thus able to regulate the amount of heat (hot combustion gases) entering each hearth of the furnace. The rabble arms are cooled by air under slight pressure and the piping system is so arranged that the heated exhaust air from the rabble arms may be utilized by introducing it into several of the hearths. In usual clay burning practice, the rabble arms do not require frequent renewal, but should this be necessary the furnace is so designed that a workman can enter the central shaft, unlock an arm and replace it with a new one without cooling the furnace.

Another feature of the Wedge multiple-hearth furnace as adapted for fullers earth burning is that both the revivifying and cooling of the earth may be accomplished in the same unit, thus making it unnecessary to provide separate cooling apparatus. The furnace has an additional hearth constructed of hollow iron castings through which water may be circulated and by this means it is possible to bring the temperature of the

earth down to whatever point the refiner desires. The upper hearths of the furnace are constructed of high-grade refractory brick.

To maintain the highest efficiency of the earth, it is necessary to provide careful control of both temperature and the time of heating. An excessive temperature such as is likely to result when the earth comes in direct contact with the oil or gas flames greatly impairs the quality of the regenerated clay.

At Okmulgee a superior earth is being recovered which can be reburned many times before it is necessary to discard it. Instead of 6 burnings which is about the present limit for lubricating oil filter earths, the average at the Empire Refinery is about 10 times. This represents a considerable saving, particularly because of the relatively high cost of the earth delivered to the Oklahoma refinery. Commenting on the quality of product being obtained, Mr. Camp states "So far as we have been able to ascertain, the burned earth has the same efficiency as new earth from the same source. The earth efficiency figure is based on a large number of comparative tests which have been made at regular intervals since the burner was put into operation and covers all kinds of earth—i.e., earth from wax filters, stock filters, viscous lubricating-oil filters, from filters handling special oils and from filters that were used for decolorizing gasoline. Tests were also conducted on earth that had been taken from the pile that accumulated during the time we were without a burner and were using temporary filters. So far as we can determine there is no material difference in any of it after having been revivified in the burner. In some tests one would show up better than another, whereas on other tests the reverse would be true. So we feel reasonably safe in stating that the burner is bringing the earth back to its original filter value."

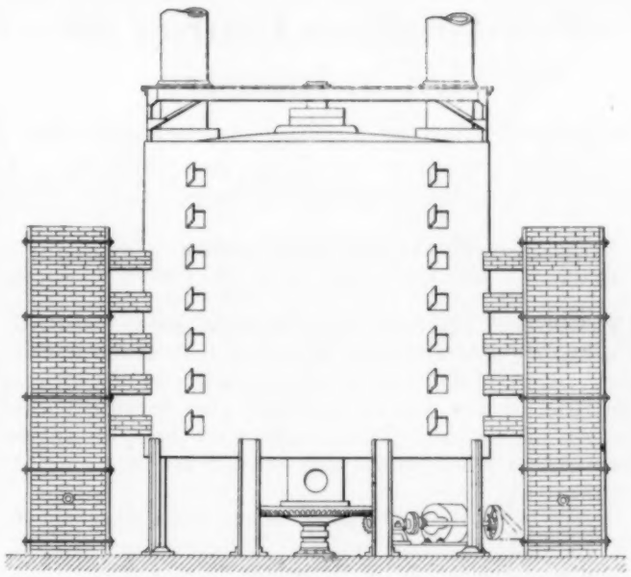


Fig. 2—Wedge Ore-Roasting Furnace Adapted for Revivification of Fullers Earth

Specially Designed Filters Used

After the earth has been revivified it is run to the storage bins located immediately over the filters. An outlet for the earth is placed over each filter so that by opening a valve the earth can be dumped directly into the filter. Even the largest of these units is thus filled in a very few minutes.

The filters, too, are of special design that makes it possible for them to be heated when necessary or they may be tightly closed and operated at low pressure. This permits a certain flexibility of operation and provides means for obtaining high quality of products at a minimum refining cost—which is, of course, one of the objects of any manufacturing or refining operation.

After the filter is charged, the oil is pumped into it, percolates down through the earth and is led into one of the sampling tanks such as is shown in Fig. 4. Each filter has a separate tank. These tanks serve two purposes. First, the stream of oil as it comes from the filter affords a ready means for the operator to judge the filtering efficiency of the earth and to ascertain when it is being exhausted. In the second place, as the tanks are filled, samples are taken periodically for laboratory examination and before the earth is run to finished storage, it must fully pass the specifications set up for that particular grade or product. In this way there is no chance of damaging the quality of the finished stocks by the addition of even small quantities of material that will not pass inspection. Because filtering is the last step in the refining of many of the products and because it is generally a costly operation, only modern equipment and skilled operators are employed.

After the fullers earth has become exhausted, the filter is washed with naphtha and is then steamed to remove as much of the oil as possible. A plate at the bottom of the filter is then removed and the earth is allowed to drop out on to the conveyor that carries it to the burner bins to be revivified in the manner that has already been described.

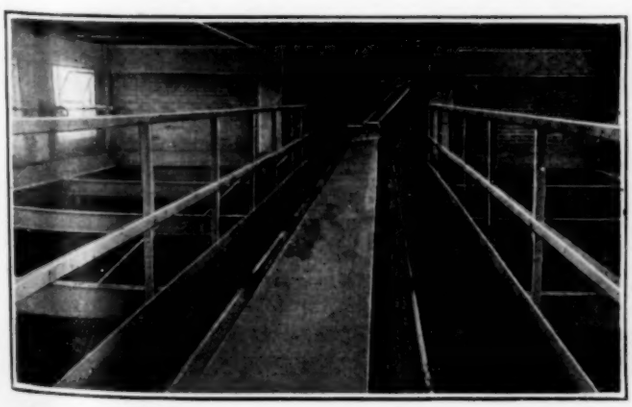


Fig. 3—Conveyor Carrying Fullers Earth to Storage Bins on Top Floor of Filter House

Fig. 4—Sampling Tanks for Filtered Oils and Pumps for Transferring Oils to Final Storage

Post-Graduate Courses for Men in Industry

Chicago's plan of evening courses provides supplementary training in physical chemistry and sciences

By Arthur Guillaudeu

Chemist, Swift & Co., Secretary, Committee on Evening Courses, Chicago Section, A.C.S.

RECOGNIZING that many technical men, employed by day, desire further classroom instruction in the more advanced divisions of science, a group of Chicago chemists worked out a successful plan to supply the needed instruction. The results have been so satisfactory that other groups may wish to follow a similar course.

Early in 1923, H. V. Main brought together about 20 chemists to attend a series of 12 lectures on Physical Chemistry, by Dr. W. V. Evans of Northwestern University. These were 2-hour lectures given once a week, and were based upon Getman's text. The members of the class represented about a dozen different industries and were drawn together by the common desire for a more complete understanding of recent developments in Physical Chemistry.

These lectures were so satisfactory that, to continue the work, a committee was organized with Paul Van Cleef as Chairman and the writer as Secretary. During the next two and a half years, this committee sponsored 6 similar courses. Of these, three by Dr. Evans dealt with Physical Chemistry; one, by Dr. W. A. Noyes, Jr., with the Chemistry of Colloids; and two, by Dr. Martin E. Hanke, dealt with Biological Chemistry.

At first a fee of $12 per course was charged each student, the entire amount being paid the instructor as his compensation. This plan was soon abandoned in favor of paying the instructor a fixed amount for the twelve lectures and pro-rating this charge between the students. Under this arrangement, the cost to the student varied between $10 and $15 per course.

The Chicago Chemists Club kindly donated the use of its quarters for a meeting place and classroom.

For about two years, the committee functioned independently of any other organization. Then, the Chicago Section of the American Chemical Society gave its endorsement by making this committee a committee of the section.

In these 7 courses, over 80 different individuals enrolled. The number in each class averaged about 20, varying from 14 to 29. The total enrollment was 140. The metal working industries, food production and the medical laboratories contributed a large number of students. Rubber working, the manufacture of paints and pigments, chewing gum, soap, tooth paste, and the refining of petroleum were among the chief interests of others. Many individuals enrolled in more than one class. Some enrolled in 5, 6 or even all 7 of the courses. Most of the students were college graduates; a few had attained the doctorate. The average age was 30 to 35 years, with wide variation between the extreme ages.

But there was room for improvement. Many wished to obtain college credit toward advanced degrees. Lecture experiments were limited by lack of facilities. Laboratory courses could not be offered. Courses were desired in related subjects: physiology, physics, mathematics, geology, etc. In fine, what was needed was graduate instruction, in the evenings, of the same quality as that offered in the daytime.

To this end, the history of the movement was recounted to the Executive Committee of the Chicago Section, A. C. S., to Dean Filbey of University College of the University of Chicago, and to Dr. Stieglitz, Dr. Whitmore, and Dr. Smith, respectively, of the Chemistry Departments of the University of Chicago, Northwestern University, and Lewis Institute. Immediately, all expressed approval of the work and offered their co-operation in a plan for extending it.

The University of Chicago having the most complete, and the most conveniently located facilities, these courses, henceforth, will be given by that university, with the co-operation of the other schools and of the Chicago Section, A. C. S. The arrangement is a most liberal one. The subjects taught may include, beside those regularly taught by the University, any others which are desired by a sufficient number. The instructors may be drawn from other universities, and from industry, as well as from the regular staff of the University of Chicago. The standards and the requirements being held as high as in daytime courses, full credit may be obtained. Laboratory courses may be arranged. For the present, each course will be equal to a "Minor" or "Half-Major." The fees are the usual University fees, plus the matriculation fee of $10 for those enrolling for the first time in the University of Chicago.

Encouraging Success of New Plan

Under this arrangement, the first lecture course was given to 79 men in the spring quarter of 1926. Dr. Harkins gave 6 lectures upon the structure of the atom and upon surface tension. Dr. Stieglitz gave 6 lectures upon the electronic theory as applied to organic compounds, the relation of constitution to color, and some examples of the application of the phase rule to organic reactions.

Seventy-nine enrolled in the course. To have so large a number was very encouraging to all who helped to arrange for it. Almost all who enrolled attended all of the lectures and are interested in additional courses. Toward the end of the course, a questionnaire was distributed to the members of the class and to all members of the Chicago Section, A. C. S. The 126 replies show that a large number wish to obtain credit toward an advanced degree. Many enjoy the lectures because they teach systematically material which has been discovered since these individuals graduated. And many enjoy them for their cultural value. Specific information obtained has enabled a number to advance in position and in salary.

Summarizing, we note that, to benefit the chemist who is employed by day, there is a large demand for advanced, up-to-the-minute instruction in chemistry and the related sciences. The rapid increase in the number of chemists, and the growing appreciation of the value of post-graduate training will cause still greater demand for such instruction. Although evening courses in undergraduate studies have been available throughout the country, post-graduate instruction has been denied, generally, to those employed by day. But by co-operation between the universities and the various organizations of chemists, the need may be supplied, benefiting the school, the individual, and the industries.

Utilization of Diphenyl Oxide in Power Generation

Discussion of the properties of this material and its use in boilers and turbines

IN the search for a means of achieving a greater efficiency in the production of power by the combustion of coal, much attention has been paid to the use of bi-fluid systems. Such systems make use of some material having a higher boiling point than water, in conjunction with water, the high-boiling-point material beng vaporized by direct heat, this vapor then giving up its power in a turbine which results in its condensation and the heat in the condensed material being used to generate steam which is utilized in the ordinary way. Such a bi-fluid system is the mercury vapor-steam boiler devised by W. L. H. Emmet and successfully operated at the Hartford Electric Light Co., Hartford, Conn.

Recently experiments have been carried out by H. H. Dow, Pres., Dow Chemical Co., Midland, Mich., which are said to have demonstrated the feasibility of a system using diphenyl oxide vapor in conjunction with steam. The findings of these experiments were discussed by Mr. Dow in a paper read at the meeting of the Associated Technical Societies of Cleveland, Ohio, May 14, 1926, and printed in *Mechanical Engineering* for August, 1926. In discussing these tests, Mr. Dow said:

Diphenyl Oxide and Its Properties

Mercury has properties that are superior in many respects to those of any other substance. It is capable of being raised to a higher temperature than any other known liquid. Any organic material has a limit beyond which it will decompose, whereas there is no temperature at which mercury will not be mercury. Accordingly, it has an unlimited field, if a material can be found that will hold and use it at extreme temperatures. This was clearly understood by the man who developed the bi-fluid system, Doctor Emmet. However, he failed to recognize the availability of the organic compound, which, so far as the author knows, has the highest boiling point with the greatest practicability, namely, diphenyl oxide. On the contrary, Doctor Emmet stated that it would decompose in a boiler. Now, the author's company happens to be the only manufacturer in the United States that makes diphenyl oxide on a large scale, and in its process of manufacture it employs a higher temperature than that at which Doctor Emmet thought it would decompose.

Accordingly, some of this diphenyl oxide was purified at various temperatures and it was found that it did not decompose under the proposed power-plant conditions, although it does if the temperature is made high enough, and the time long enough.

Diphenyl oxide is a white solid at room temperature, but a liquid if it contains a slight amount of impurity. It melts at 81 deg. F. when very pure. The fact that it is a solid is a slight objection, but any part of the boiler room where it would be used would have a temperature above 81 deg. Its specific gravity is 1.083 and its boiling point at atmospheric pressure is 258 deg. C. or 496 deg. F., which is the temperature of saturated steam at 680 lb. pressure.

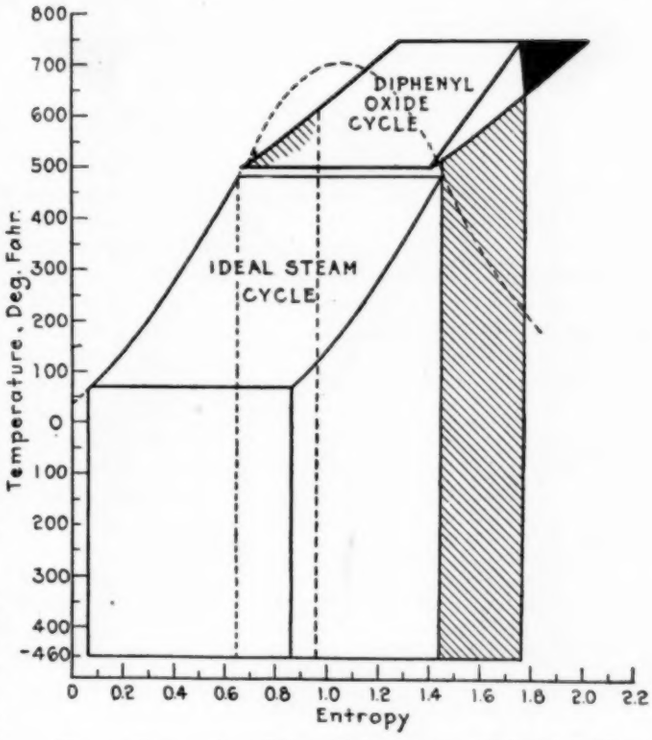


Fig. 1—Temperature-Entropy Diagram for Diphenyl Oxide Bi-Fluid Plant

In this plant the diphenyl oxide is expanded from 135 lb. to atmosphere and the steam from 600 lb. to 29¼ in. vacuum

At 200 lb. pressure its boiling point is 800 deg. F. Its specific heat is approximately 0.4. Its critical pressure is 465 lb. at a temperature of 530 deg. C. or almost 1,000 deg. F. Another physical property not often recorded in the tables is its price. In quantity lots it is worth 30 cents a pound. It can be produced in unlimited quantities, and the cost per unit volume is less than 2 per cent of the cost of the same volume of mercury. This is one principal reason for advocating diphenyl oxide in bi-fluid power systems.

One of the thermodynamic properties of diphenyl oxide is that in an ordinary turbine where it expands adiabatically, instead of condensing like water it superheats to a marked degree, even in a 100 per cent efficient turbine. For example, when the vapor expands from 135 lb. gage down to atmospheric pressure where the boiling point is 500 deg. F., the temperature, instead of being 500 deg. is about 625 deg.

Superheating Effect

This extreme amount of superheating has an advantage and a disadvantage. It is difficult to transfer heat from a superheated vapor. Accordingly, when this vapor is exhausted at 625 deg. it is necessary to use it regeneratively to heat the boiler feed in order to get 90 per cent of the Carnot cycle, otherwise the efficiency of this cycle would be only 75 per cent. We have 15 per cent as the goal to be gained by using regenerative heating, that is, taking the exhaust superheat from the turbine and using it for reheating the boiler feed, which corresponds to bleeding in an ordinary steam installation. A certain amount of this can be done, but whether or not it can be brought up to 90 per cent without prohibitive expense, has not yet been demonstrated.

Another advantage of diphenyl oxide is that the

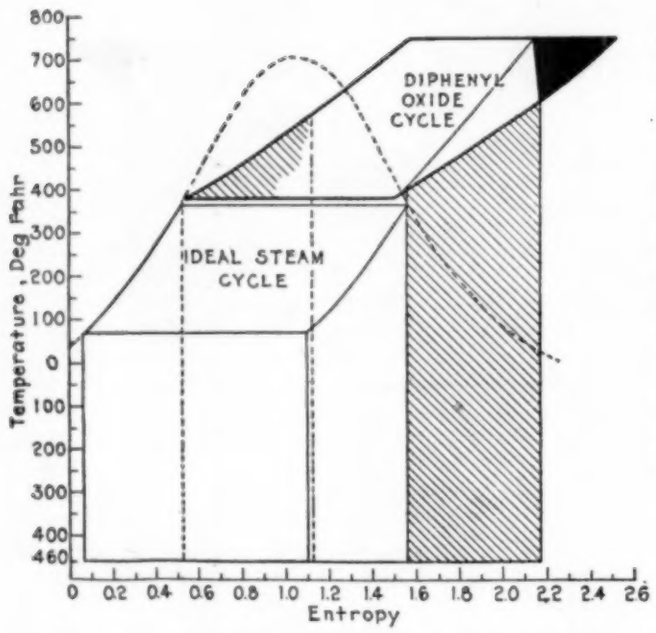


Fig. 2—Temperature-Entropy Diagram for Diphenyl Oxide Bi-Fluid Plant

In this plant the diphenyl oxide is expanded from 135 lb. to 24 in. vacuum and the steam from 150 lb. to 29¼ in. vacuum

weight of its vapor is about 9.4 times that of steam vapor. This means that a diphenyl-oxide turbine will run at a lower speed with higher torque for the same horsepower than a steam turbine, which is a great advantage. It may be that on that account we shall get a little higher turbine efficiency, and we shall certainly get some higher turbine efficiency by reason of the fact that there is never any condensate in the diphenyl oxide vapor.

One difference between diphenyl oxide and mercury is that the latter does not wet steel, and on this account the boiler tube may be much hotter than the mercury; whereas diphenyl oxide does wet the tube, so that it is easier to transfer the heat from the boiler to the diphenyl oxide.

A Proposed Diphenyl-Oxide Bi-Fluid Power Plant

For these various reasons the author feels very confident in proposing the diphenyl-oxide bi-fluid plant working between 750 and 70 deg. F. The diphenyl-oxide vapor would be generated in a boiler at 135 lb. gage pressure and expanded to a vacuum depending on the steam pressure with which it is desired to work. The temperature-entropy diagrams show two such combinations, one, Fig. 1, in which the diphenyl oxide is condensed at atmospheric pressure, making steam of about 600 lb. pressure, and the other, Fig. 2, exhausting at about 24 in. of vacuum, making steam at 150 lb. pressure.

The black area in each diagram represents the difference between the Rankine and the Carnot cycle in the proposed diphenyl-oxide cycle. The saturated vapor enters the turbine at 750 deg. F. and expands to the exhaust pressure with a temperature considerably higher than the condensing temperature. The superheat in the vapor, represented by the shaded area, is then removed in a counterflow boiler-feed preheater. The heat of vaporization at the condensing temperature is given up to the water in the condenser boiler and the liquid diphenyl oxide is returned to the boiler through the preheater. The steam should be superheated by direct heat or by diphenyl-oxide vapor in order to gain the increase in the efficiency of the turbine.

As to the instability of diphenyl oxide when heated, some of it was boiled in an iron boiler for a month at 830 deg. night and day. At this temperature there was some decomposition after a month—in the neighborhood of 1 or 2 per cent. It was then boiled at 135 lb. pressure, which corresponded to 750 deg. F., and the decomposition decreased to a fraction of 1 per cent. Thus diphenyl oxide has actually been employed within the temperature ranges discussed in the paper without serious decomposition.

There is some phenol formed in the diphenyl oxide, but it acts in the same way as the diphenyl oxide, except that it modifies the thermal properties to a slight extent. There is a slight amount of decomposition incident to the amount of oxygen in the system at the start, but only a fraction of 1 per cent.

Commercial Possibilities

As to its commercial possibilities, they are much greater where coal is high priced than where it is cheap. In the future, as coal prices get higher, coal will be a much more valuable material, and more desirable, than it is now. It will also be more desirable to use it on a very large scale than on a small one because of the economies thus possible.

For a given horsepower, the volume of a diphenyl-oxide boiler will be the same as that of an equivalent steam boiler. However, the former boiler is distinctly different on account of the very low latent heat of diphenyl oxide. The tubes have to be short and it is necessary to have some special means of circulation, either a circulating pump or special construction to give maximum circulation. Diphenyl-oxide vapor against hot metal surfaces would be undesirable.

Aging of Soft Rubber Compounds

In connection with the general investigation of the aging properties of soft rubber compounds, the Bureau of Standards has found that a certain light-colored compound retained its life very well if kept in the dark but deteriorated rapidly in sunlight. Some tests were made to determine whether or not the deterioration in sunlight of this particular compound could be retarded by coloring. In order to obtain data on the effect of color, two compounds were made—one in which 2 per cent of carbon black was added and one in which 2 per cent of red oxide was added to the original compound. The three compounds—one white, one red, and one black—were then simultaneously exposed to sunlight for 6 months and tests made at intervals of 2 months to determine the deterioration of each.

The results showed that during this period, the rate of deterioration of the light-colored compound was about five times as great as that of the black and about twice as great as that of the red. While quantities of coloring materials added to the compounds were not sufficient to affect the tensile properties appreciably, exposure to light showed that the aging characteristics were greatly changed.

These tests point to the advantage of using dark-colored compounds in rubber articles which may be exposed to sunlight.

Scrap Detinning Affords Big Outlet for Chlorine

Recovery of tin and its salts from tin-plate scrap rapidly becoming an industry of great proportions

By C. L. Mantell
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TIN plate scrap, made as a result of working up of tin plate into cans, boxes, containers, etc., has been the subject of much study, because in its plated state the scrap cannot be puddled or charged into the open hearth furnace. The tin coating, as a result of the oxidation of the tin, prevents a satisfactory iron or steel product being made. Hundreds of patents in all the different industrial countries have been granted for the removal of this coating. The tin coating has a considerable value, either as metallic tin, or as tin salts, used in various industries.

Many of the chemical and electrochemical processes were failures, as were most of the mechanical processes, either because the acids used attacked the iron as well as the tin, or because they would not dissolve the tin sufficiently and left a considerable part adhering to the iron. It was found in many cases that the chemicals used were too expensive to make the process an economical one. Three processes, however, have operated successfully and have been more or less in competition with one another for the last forty years, during which time one or another has alternately gained preponderance, due to refinements in that process over the others. These three processes are the electrolytic alkali process, the alkali chemical process and the chlorine process.

History of Early Electrolytic Processes

As far back as 1876, Keith (*U. S. Patent* No. 176,658) recommended the electrolysis of tin scrap in an alkali solution, while in 1882 Thomas Goldschmidt, in Germany, conducted experiments with a warm solution of caustic soda, using the tin plate scrap as the anode and an iron plate as the cathode. This simple idea has been the basis for the further development of the industry. The operation on a plant scale offers difficulties, both electrochemical and mechanical, which have been solved in commercial operation.

The tin is recovered at the cathode in the form of a spongy or finely granulated precipitate, which can be removed and melted. The process yields a serviceable iron in a single operation, which may be compressed into solid billets, and for which a market can be readily found. The apparent simplicity of the method caused it to come into quite general use in a comparatively short time, so that up to about 1907 it dominated the entire field.

A second process of considerable commercial importance is that of detinning with hot aqueous alkalies, with or without the aid of oxidizers. This method was practiced at an early stage of the industry, but did not always remove a sufficient amount of tin. It is only within recent years that this process, using alkali and saltpeter, has been developed to a point where the commercial results compare with the product of the chlorine process. The tin oxide resulting is used extensively as a coloring matter in the enamel industry, or is smelted in reverberatory furnaces to form marketable pig tin.

The chlorine process was first taken up by Higgins in 1854, in England (*English Patent* No. 766, 1854) and later by Parmalee (*U. S. Patent* No. 102,148). Seeley (*U. S. Patent* No. 135,578) and Panton (*U. S. Patent* No. 135,578) in the United States.

In 1883 there was a plant operating successfully, using the chlorine process, at Metikon, on Lake Zurich, Switzerland. A fixed iron cylinder, 13 ft. high, of 39 in. diameter, was used. The cylinder had a perforated false bottom, on which the cuttings were placed, and through the openings of which the chlorine gas passed and came in contact with the clippings. The stannic chloride, which was formed, collected as a refining liquid in a receiver under the cylinder.

Further progress was made in chlorine detinning in 1885, when Lambotte, in Brussels, started to operate on a large scale with a shaft furnace, filled with tin scrap from the top, while chlorine gas, strongly diluted with air, was introduced at the bottom. The air carried away the stannic chloride to the condensers, where it was condensed as a watery solution of the stannic chloride. The detinned clippings were then removed from the bottom of the furnace and compressed into billets.

A chlorine detinning plant was established in New York in 1873, operating according to the Seeley patent, but the concern failed when the financial panic of that year brought ruin to many concerns.

Goldschmidt Process Widely Used

It was not until 1907 that the chlorine detinning process gained real importance. In that year Thomas Goldschmidt, one of the pioneers in the detinning industry, abandoned the electrolytic process entirely, in favor of the chlorine process, which he had developed. Since then the chlorine process has grown rapidly, and today there are immense quantities of tin scrap and old tin cans detinned by this method.

Some of the basic conditions of chlorine detinning had been correctly observed by the early experimenters, the most important of which is that all humidity must be excluded, in order to avoid any corrosive action of the chlorine on iron. It has also been found that the material must be free from all organic substances, such as paper, straw, varnish, etc.

Fundamental Chemistry of Detinning

Chlorine gas will combine with tin, under the development of considerable heat, to form anhydrous tin tetrachloride. This is a heavy liquid, which fumes strongly in air. It has been known to chemists for about 300 years. In fact, as early as 1605 Libavius described this product, and ever since that time it has been known under the name of Liquid Fumans Libavii. By cautious addition of water to this fuming liquid, solid stannic chloride crystals were precipitated, and sold in that form to be used in dyeing.

The thermal datum of the reaction is $Sn + 2Cl_2 = SnCl_4 + 127{,}250$ calories. The heat of formation of stannic chloride is given by various authorities at from 127,250 calories to 129,600 calories. The heat of a solution of stannic chloride is 29,920 calories. It has a density of approximately 2.29, a melting point of —33 deg. C. and a boiling point of about 114 deg. C. It dissolves readily in water, forming a solution from which the hydrated stannic oxide separates on boiling or standing.

Paper presented at the forty-ninth general meeting of the American Electrochemical Society, held in Chicago, April 22-24, 1926.

In the operation of the chlorine gas process all the following precautions must be observed, and must be strictly adhered to in order that the operation may not be a failure.

Perfectly dry chlorine gas or mixtures of chlorine and other gases only can be used. Moisture even in small quantities is detrimental to the process. Only dry clippings can be detinned. The clippings must be clean. Chlorine will only slightly detin dirty, greasy or oily clippings. The process cannot be used for unclean tin plate scrap.

Provision must be made for keeping the temperature of the reaction chamber below 38 deg. C. or 100 deg. F., otherwise the iron of the chamber or detinning vessel will be affected by the chlorine to form ferric chloride. Chlorine also acts on the iron in the presence of water, the ferric chloride formed accelerating the attack of the chlorine on the iron.

The chief difficulty of this process was that the iron scrap was exceedingly liable to rust, as was the case with all former processes of detinning with chloride. Even if all moisture were carefully avoided, and the resulting steel gray iron were stored in a very dry place, it would rust and the resulting corrosion would quickly spread. It was found that chlorine is not absolutely without an attack on the iron, but forms a thin invisible film of anhydrous ferric chloride, which will attract water from the air and rusting will result. The ferric chloride is reduced to ferrous chloride, and this again attracts oxygen and water from the air, forming oxy-chloride; this is again reduced by the iron, forming more rust. The corrosion of the iron was prevented by removing the ferric chloride film by a washing process.

Many Modifications of Chlorine Process Have Been Developed

The most important modifications of the chlorine process are those of Goldschmidt, Sperry, Acker and Von Schutz. There have been manifold and multitudinous methods and apparatus proposed and used, for practically all of which patents have been granted. The same result can be obtained in many different ways.

In the Goldschmidt process chlorine is introduced into the detinning chamber under pressure. The dry tin scrap is put into large cylindrical containers, either in more or less loose form or compressed into baskets. These containers, after being filled, are closed tightly. Dry chlorine is then introduced. The heat of reaction of the chlorine on the tin is dissipated by outside cooling of the reaction chamber. After detinning has been completed the remaining gases are drawn off by suction, along with any volatilized stannic chloride, and the detinned bales of scrap washed and dried. The detinned scrap is then ready for sale.

Pressure is used in the Goldschmidt process to cause the reaction gas to penetrate all parts of the scrap material in the reaction cylinder. When the gaseous chlorine forms liquid tin chloride, the pressure is reduced due to the decrease in volume of the gases. As long as the pressure continues to drop, detinning is taking place. When the pressure remains constant for some time it is evident that the chlorine does not find any more tin with which to combine. This is a sure indication that the detinning is completed.

It is stated that the pressures employed in the Goldschmidt process are about 3.7 atmospheres at 0 deg. C., and 7.6 atmospheres at 25 deg. C.

In the method of Von Schutz a dry mixture of chlorine, diluted with other gases (as dry air), is drawn through the scrap by suction. Any inflowing gases which are too cold can be reheated, by being passed through pipes around which exit gases of the process are drawn off; these exit gases being heated by the heat of the detinning reaction. The vacuum is produced in part by the cooling and contraction in volume of the exit gases. Little trouble is experienced with clogging of the pipes, due to the deposit of stannic chloride.

The detinned scrap is washed in the same cylinder in which the detinning was done; and drying is done in place, after washing, by blowing hot furnace gases through the tin scrap bales in the detinning chamber. The finished material is removed from the chamber and sold.

Von Schutz, Acker and Sperry Processes

The Von Schutz process has the advantage of having a shorter detinning time, simple apparatus, and little manual handling as the detinning, washing and drying is done in the same equipment.

The method of Dubois and Kaufman consists in employing chlorine in a solvent such as carbon tetrachloride. The tin salts produced and the solvent are recovered by the addition of water or steam. If desired, the solution of the tin salts in carbon tetrachloride may be electrolyzed after addition of water.

In the Acker process liquid chlorine, which continuously sets free chlorine gas, is used as a detinning agent.

Sperry uses mixtures of stannic chloride, and chlorine in the presence of stannic chloride, usually in a closed system. The vapors given off are cooled and condensed, in chambers in the system outside of the reaction chamber.

Von Kugelen and Seward, in patents assigned to the Tin Products Co. of New York, use a process which depends on arranging the amount of scrap to be treated so that the heat generated by the detinning can be dissipated rapidly enough to maintain the temperature below the point at which chlorine attacks iron. The stannic chloride is removed by volatilizing it in a current of chlorine. In other patents Von Kugelen and Seward condense the stannic chloride in the detinning chamber. They also have the idea of keeping that part of the detinning chamber adjacent to the walls at approximately 38 deg. C.

Leitch has patents for a process in which the scrap is detinned by chlorine, while submerged in stannic chloride, the residual gas being removed by exhausting and cooling the chamber. In another patent dry chlorine and stannic chloride are used alternately.

Von Schutz, in all his patents and in the operation of his process, avoids pressure to as great an extent as possible, carrying on the process under suction or reduced pressure. Von der Linde has patented the idea of diluting the chlorine with air by various means.

Advantages of Chlorine Detinning

The chlorine process possesses advantages over the electrolytic method, as it can be carried on in larger units, and the labor charges are therefore materially reduced. The detinning is somewhat more thorough. Less tin is lost than in the competing processes. The tin is recovered in the form of tin tetrachloride, which is a valuable chemical product, extensively used in the silk dyeing industry.

Practically all the corrosion problems in handling of commercial dry chlorine gas have been successfully solved. Transporting and handling gaseous chlorine, while less easy than other commercial gases, is not relatively difficult.

Cost of Chlorine Detinning

Plants for recovery of tin from tin plate scrap are fairly simple, but need to be designed with due regard to many important details. The plant cost will vary considerably with size of plant, from $15 to $20 per ton of scrap handled, for a yearly capacity of 1,500 tons to as low as $8 to $10 per ton of scrap handled in a plant taking care of 10,000 tons per year. These figures include all mechanical equipment necessary, such as baling presses, overhead cranes, chlorinators, pipe lines, chlorine compressors, etc., and include the cost of steel frame and brick buildings.

Tin plate scrap has no market as such, on the other hand detinned scrap has a ready sale. Stannic chloride crystals are in constant demand; salable at an attractive price. If the manufacturer desires, tin metal can be recovered from the stannic chloride, with a good margin of profit on the tin recovery from the original scrap, but not as large as if the stannic chloride crystals are disposed of as such.

The cost of handling a ton of tin scrap in process, including all labor, interest, taxes, depreciation, materials (as chlorine), repair and maintenance is just about equal to the amount obtained per ton of detinned scrap, when it is sold as baled scrap on the open market. This cost of handling does not include the nominal cost of the original tin plate scrap. The values obtained then for the stannic chloride produced (or the tin recovered from such) are entirely on the profit side of the ledger.

Economic Importance of Detinning Industry

There will be consumed approximately 80 to 100 lb. of chlorine per ton of tin plate, of the quality and weight of tin coating on tin plate commonly used for tin cans. There are manufactured for food products alone in the United States enough tin plate containers, so that each one of us is responsible for the consumption of at least one can per day for every day in the year. The amount of scrap resulting from the fabrication of these containers is tremendous. With increasing prices of tin, recovery of tin becomes of greater and more pressing importance. Chlorine detinning in the United States outbids all competing processes, to aid in the utilization of the huge amounts of tin plate scrap, which would otherwise be a total loss and a great economic waste.

Fertilizer Simplification

About 75 company members of the National Fertilizer Association have furnished data on the 3,220,000 tons of product made by them, from which John J. Watson, president of International Agricultural Corporation, was able to summarize the present situation. Over 709 grades of fertilizer were made; but 25 grades accounted for 75.2 per cent of the output and 174 analyses for 96.76 per cent. Only 50 grades were of enough importance to amount to as much as one-quarter of one per cent of the total apiece. Thus both the opportunity for and need of simplification of brands and varieties was made clear.

Phosphoric Acid as a Carrier For Ammonia

Use of ammonium phosphate as fertilizer depends upon cheap production of phosphoric acid

One of the main difficulties now standing in the way of utilizing synthetic ammonia as a source of agricultural nitrogen is the finding of a suitable carrier for the ammonia. There would presumably be little advantage in making ammonium sulphate, since the country is already producing a surplus of this material. In Germany, urea is being produced from ammonia and carbon dioxide and we are advised by German representatives in the United States that they are prepared to sell urea c.i.f. U. S. ports in 1,000-ton lots at a price per nitrogen unit lower than the cost of nitrogen in Chilean nitrate. There is at present a 35 per cent ad valorem duty on the material.

There has been much talk recently of using phosphoric acid as a carrier for ammonia. Ammonium phosphate has much to recommend it and would no doubt find ready acceptance by the fertilizer industry if it could be produced cheaply enough. At present there is no processs in commercial operation in the United States which can produce phosphoric acid more cheaply than does the ordinary sulphuric acid method. An electric-furnace method has received a good deal of attention at Anniston, Alabama, where the Federal Phosphorus Company is manufacturing phosphoric acid, practically none of which, however, is used as fertilizer. The cost of manufacturing phosphoric acid by the method used at Anniston is, of course, dependent largely on the cost of electric power and it does not seem likely that phosphoric acid can be manufactured in this way cheaply enough to be used as fertilizer.

The Victor Chemical Works has been for some time experimenting with a fuel-fired furnace for producing phosphoric acid but the process remains still in the experimental stage. The Liljenroth scheme for producing phosphoric acid has recently attracted considerable attention. In this process ordinary yellow phosphorus is first produced in an electric furnace. The phosphorus is then blown in vapor form, together with steam, over a catalyst at about 1000 deg. C., whereby phosphoric acid is formed with liberation of hydrogen. It is proposed to use the hydrogen for the manufacture of synthetic ammonia which could then be combined with phosphoric acid to produce ammonium phosphate.

A recent report from Germany is that the Badische Company has remodeled one of its cyanamide plants to use the Liljenroth scheme. The particular cyanamide plant utilized had a nitrogen capacity of 30,000 tons per year, and if all of this plant has been converted it is evident that the Germans are trying out the process on a large scale, presumably for the manufacture of Diammonphos and related products. It is doubtful whether the electric furnace method of producing phosphorus for fertilizers can be employed advantageously in this country unless it be found possible to use seasonal power, in which case the phosphorus would have to be stored in sufficient quantities to permit closing down the phosphorus furnaces during low water periods on hydroelectric developments. If this proved practical the process would then appear to have possibilities as a means of using secondary power at Muscle Shoals.

Drying by Recirculation of Air

Apparatus developed for food dehydration by the Department of Agriculture suggests improvements in general drying practice

By W. A. Noel

Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C.

AFTER several years of research by the U. S. Department of Agriculture, in which nearly all types of driers and the problems connected with them were studied, a dehydrator of two fresh tons capacity was built at Los Angeles, California, and operated on a semi-commercial scale on several fruits and vegetables. This apparatus and the fundamental principles involved in its design and operation suggest improvements in drying practices with many other materials.

The design of this duplex drier is such that it may well be followed in any industrial plant where drying is one of the operations in the process of production.

In conditioning the air for use in drying fruits and vegetables, or any other product for that matter, it is necessary to know the temperature and humidity best suited to the product being treated. And, knowing these, it becomes the business of the engineer to bring about the proper conditions and maintain them throughout the drying period, or to alter them progressively through the period if the product shows that it dries best when different temperatures are used during different stages of drying.

It is obvious that during the early stages of the drying period, when the product contains the most moisture and when it is evaporating most readily, the refrigerating effect on the product as well as on the drying medium is the greatest. This is the time when the highest temperatures may be used.

In designing the dehydrator cognizance was taken of the refrigerating effect of evaporation on a drying medium, as demonstrated by the wet bulb of the hygrometer. The development of a type of drier was undertaken in which it would be possible not only to use maximum temperatures at the time of maximum evaporation from the product being treated, but also at the same time to control temperature and humidity of the drying medium and the distribution of it as well.

Heat is not such an expensive item in the total cost of dehydration that it requires much thought. Uniformity of drying, however, is a much more troublesome problem and one that costs the manufacturers dear. Their common practice has been to assort the products after taking a truck load from the drier, picking out the dry and returning the trays of poorly dried to the drier for redrying. This unnecessary work not only adds expense but produces an inferior dried product.

Proper distribution of the conditioned air is perhaps the most important fundamental in drying and the most unusual of attainment. The flow of air over the trays should be uniform, so that drying will proceed uniformly over the entire spreading area of the tray surface. If this condition has been met in the design of the drier, the entire charge of the product will be dried to the same degree when removed from the drier. If the product is not uniformly dried, it will in all probability be due to a varying degree of maturity or size of the fruit. To avoid this variation of product, grading should precede processing, uniform material being put onto the trays of each truck.

Speed in drying is essential. On it depend the capacity of the drier and the day's or season's output. As the rate of evaporation is in direct proportion to the temperature, it is advisable to start the drying with a high temperature and suitable humidity, gradually reducing the temperature and humidity to the end of the drying period when the products have but little moisture left to protect them from scorching.

Tieman, U. S. Department of Agriculture (Bulletin No. 509) states that in drying lumber the actual temperature of the wood, while it is moist, is that of the wet bulb, provided there is sufficient circulation. In our investigations we did not find that the vegetables or fruit being dried were at the same temperature as the wet bulb. While considerable evaporation was taking

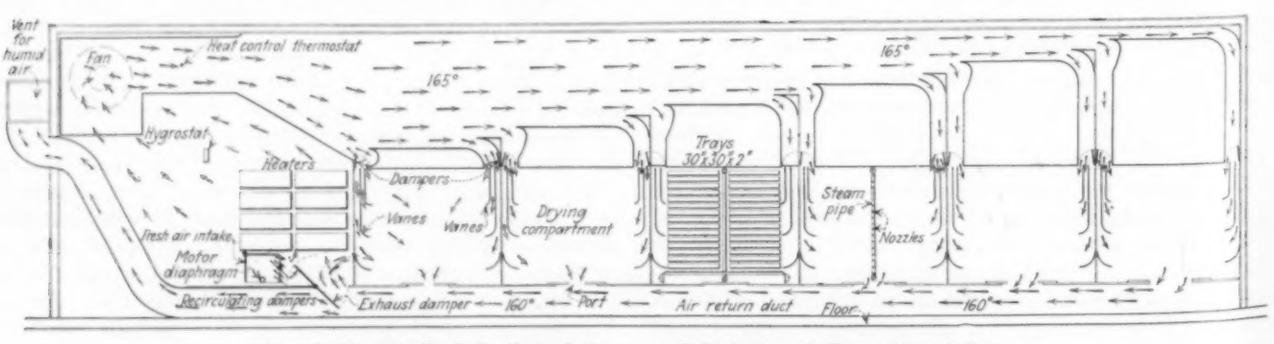


Fig. 1—Longitudinal Section of Dryer or Dehydrator of Compartment Type
This design was developed as a result of research carried on by the U. S. Department of Agriculture in connection with the dehydration of fruits and vegetables. Air circulation is shown by arrows

place the fruit showed a temperature that ranged about midway between the temperature of the wet bulb and the temperature of the dry bulb hygrometer. After evaporation had slowed down perceptibly the temperature of the fruit began to rise and by the end of the drying period it had closely approached the dry bulb temperature.

The optimum drying temperature for apricots is considered to be 150 deg. F. After 7½ hours drying in air at 175 deg. F., it was found that the fruit had become heated to 150 deg. F. The temperature of the drying air was then cut down to 150 deg. F. and the drying finished. An excellent dried product was obtained. The total drying time of 12 hours could no doubt have been shortened by using a greater blast of air. Similar adjustment of temperature during drying should be made for each material dried.

It is not possible, of course, to use this system in a progressive or tunnel drier. In describing tunnel driers where the products move through the drier in the same direction as the air, the term "con-current" is used; in describing tunnel driers where the products move through the drier in the opposite direction to the air the term "counter-current" is used. In the first type the products are subjected to hot dry air at the start of drying and cool moist air at the finish. In the second type the products are subjected to cool moist air at the start of drying and hot dry air at the finish. In either case accurate conditioning of the air in a tunnel drier for general use is impossible and, at the present time, the requirements in a dehydration plant call for a drier in which all vegetables may be successfully and cheaply dried. With the dehydrated fruit industry attaining a prominent place in our food supply, a drier must meet the requirements of handling apples, apricots, prunes, peaches, pears, etc., as well as carrots, corn, onions, potatoes, spinach, tomatoes, and berries.

The dehydrator developed as a result of the Department's work is a compartment type, as distinguished from the tunnel type, and is shown in Fig. 1. Since the blanching operation may be done in the drying compartment, thus retaining the heat and moisture in the steam used for blanching, the dehydrator serves a double purpose. In addition to economies in heat, there is a saving in labor for handling trays and trucks over that required in a factory where it is necessary to transfer them from the blancher to the drier. The dehydrator is 60 ft. long, 14 ft. high and 4 ft. wide. There are six compartments, each of which accommodates one truck holding 30 trays. Each tray is 30 inches square and 3 in. deep. This gives a total spreading area of 1,125 sq.ft. Each compartment is a complete drying chamber independent of the others and may be used alone with all the others shut off, or it may be used in conjunction with any or all of the others. One of these compartments is shown in Fig. 2. A seventh compartment houses the radiating units and the blower fan. Steam is used as a heating medium to warm the air. A large blower fan, motor driven, is used to circulate the air through the drying compartments. The air leaves the fan at the rate of 18,000 cu.ft. per minute and is distributed by means of a short sheet iron duct, vanes, and sluices to the different trays, passing from the top down and horizontally across the trays, then down through a port in the bottom into a return duct, by which it is returned to the radiators and reheated the few degrees lost in one circuit.

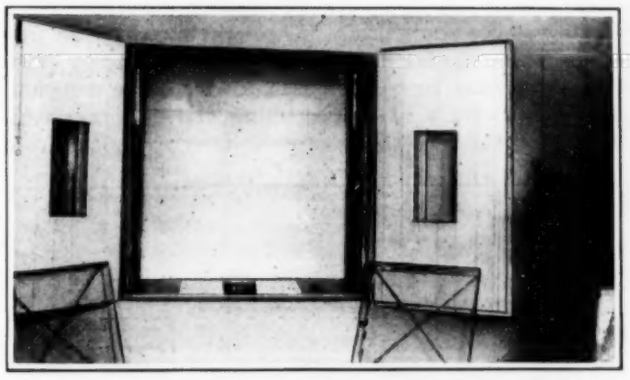


Fig. 2—One of the Compartments of the Dryer During Construction
This view shows the vanes on the sides; the dampers at the top of the vanes which when shut stop the circulation of the air through the chamber; and the port at the bottom, partly open

In dividing the air among the six compartments each one gets one-sixth of the total amount, or 3,000 cu.ft. This amount is divided by a sluice that gives 1,500 cu.ft. to each half of the chamber, which is further divided by the vanes on each side into three equal parts, or 500 cu.ft. is apportioned to five trays. Each tray being 30 in. square takes one-fifth of the 500 cu.ft. or 100 cu.ft., which is spread over the 30-in. surface at the rate of 3⅓ cu.ft. per in. per minute. This 3⅓ cu.ft. of air per minute passes over a strip of the tray surface 1 in. wide by 30 in. long, coming in drying contact with only 30 sq.in. of material in one complete cycle. Thus we are making use of a fundamental principle of heating and ventilating in that it is cheaper to move air than to heat it.

Temperature control is effected by an indirect-acting duct thermostat of the intermediate or gradual movement type. This gives a gradual motion to the valve in the steam line and holds it firmly in any intermediate position, provided that the desired temperature prevails at the thermostat. The temperature of the air is controlled by the amount of steam which passes the diaphragm valve on its way to the vento heaters. The flexible thermostatic disk is in the outlet duct leading from the fan and is filled with a low-boiling liquid. When the temperature of the air surrounding the disk in the duct leading from the fan rises, the disk expands, due to volatilization of the liquid within, and flexes a diaphragm which opens a valve in the thermostat. This valve permits air to pass through the air line from the air compressor storage tank to the diaphragm valve on the main steam supply line, closing it. When the temperature of the air in the duct drops the thermostatic disk contracts and the compression spring closes the valve in the thermostat, cutting off the supply of air from the air compressor. This opens the air escape port and allows the compression spring in the diaphragm valve to open it so that steam may again flow into the radiators. By use of a key, adjustments may be made for any desired temperature within the operating range of the disk. The regulator is provided with three interchangeable disks good for an operating range of 110 to 135, 135 to 160, and 160 to 190 deg. F., respectively. By this means the air is held at any predetermined temperature with a variation of not more than one degree plus and minus, which gives a practically constant temperature in all six of the drying compartments.

The temperature may be varied in the compartments by setting the damper in the port at the bottom of the

compartment for a larger or smaller opening. This varying of the temperature is brought about by the pull of the fan on the air flowing through the opening. With a large opening more air passes through the compartment than with a smaller opening and a higher temperature results, as the greater volume of air carries a

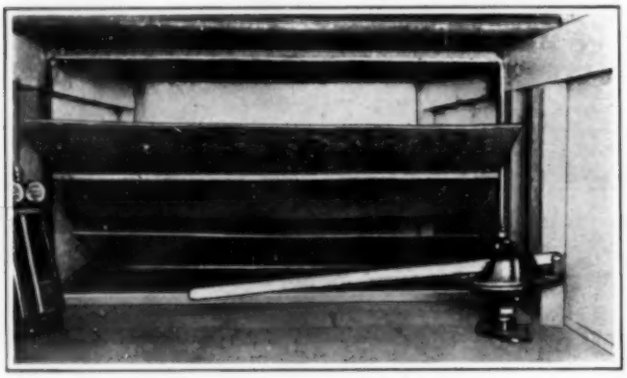


Fig. 3—View of the Humidity Control
At the left is the hygrostat which operates the diaphragm valve (activated by compressed air) shown at the right. This valve moves the dampers, one permitting the entrance of fresh air and the other the exit of saturated air

greater number of heat units and compensates for the refrigerating effect of evaporation on the air.

The humidifying and dehumidifying of the air is done by carefully regulating a set of dampers, either by hand or by an automatic device. Fig. 3 shows the automatic regulating installation. The dehydrator is equipped with a hygrostat which regulates the amount of compressed air admitted to the damper motor. A high humidity saturates the wooden member of the hygrostat and deflates the motor diaphragm, opening the pair of dampers, one permitting the admission of fresh atmospheric air and the other permitting an equivalent amount of saturated air to exhaust to the atmosphere. When this exchange of air has reduced the amount of moisture present in the mixture to the desired per cent relative humidity, the hygrostat passes air to the motor diaphragm, inflating it. This closes the dampers and effects complete recirculation of the air. The moisture given off by the drying material may be the sole source of vapor for conditioning the air under this automatic control.

The action of the hygrostat is direct, so that the movement of the dampers is positive in opening and closing. Moreover, the amount of air passed by the dampers is proportioned so that the change in humidity is so gradual that any desired relation may be obtained.

One feature in which this dehydrator differs from any other is in its adaptability to the blanching operation so necessary in drying vegetables. Perforated pipes which discharge steam through small nozzles are located in each compartment. These pipes are supplied with steam by a 1-in. pipe. There is a valve to control the flow of steam to each compartment. Products to be blanched are put into the compartment, the valves at the top of the compartment are closed, and the port in the bottom is closed. Then the steam valve is opened and the steam flows through the nozzles, filling the compartment and thoroughly blanching the products. The valves at the top of the compartment and the port in the bottom are then opened and the circulation of air promptly clears the vapor from the compartment and drying proceeds.

Economy in the Design of Cylindrical Tanks

Method of determining the economical balance between material required and length of tank seams

By Samuel Cottrell
Trojan Powder Co., Allentown, Pa.

IN DETERMINING the proportions of a proposed cylindrical tank, the engineer is very often limited by the amount of space at his disposal or by other considerations, such as headroom, equipment already in place, or equipment that is to be placed within the tank itself.

But where a large number of tanks are to be constructed, and particularly in a wholly new plant or installation, a considerable saving in both material and labor may be effected by the selection of the proper size of tank for a given capacity. This will be found to be especially true in the case of "hand made" tanks of lead, copper, aluminum, etc., which are often erected and made where they are to be used. Machine made tanks may be varied in size with little difference in the cost of fabrication, but there will be the same variation in the cost of material as there is in the case of other tanks.

An application of the principles of maxima and minima will show that for a tank of given capacity, there is one size that will require the least amount of material, and another size that will have the shortest length of seam. If the cost of material and the cost of making the seam or joint be known, then an expression may be derived which will show the ratio of height to diameter to be employed to give the most economical tank for the capacity desired. This ratio will not be the same for a tank closed at both ends as for a tank which is open at one end (vertical open tank).

Method of Calculation

For example, suppose we have an upright cylindrical tank of radius r and height h closed at both top and bottom. The volume, V, is equal to $\pi r^2 h$ and is a constant in the following discussion. The surface of the tank determines the amount of material to be used in its construction, and the surface S is represented by

$$S = 2\pi r^2 + 2\pi rh$$

Differentiating this expression with respect to r and setting the derivative equal to zero, we find

$$\frac{dS}{dr} = 0 = 4\pi r + 2\pi h + 2\pi r \frac{dh}{dr}$$

To evaluate $\frac{dh}{dr}$

$$V = \pi r^2 h$$

$$\frac{dV}{dr} = 0 = 2\pi rh + \pi r^2 \frac{dh}{dr}$$

$$\pi r^2 \frac{dh}{dr} = -2\pi rh$$

$$\frac{dh}{dr} = -\frac{2\pi rh}{\pi r} = -\frac{2h}{r}$$

Substituting this value in the expression for our first derivative, and evaluating h we find

$$h = 2r$$

In other words, in a tank of capacity V with both ends

closed, the least material is required when the height is made equal to the diameter.

If the top of the tank were open, we should find by the same method

$$h = r$$

That is, in an open tank, the least material is required when the height is made equal to the radius.

Suppose now that in the closed tank there are circumferential seams where the two heads join the cylindrical part, and a seam along the length of the tank from end to end. Then the length of seam L in the tank is

$$L = 4\pi r + h$$

Differentiating as before

$$\frac{dL}{dr} = 4\pi + \frac{dh}{dr}$$

$$\text{Now } \frac{dh}{dr} = -\frac{2h}{r}$$

$$\text{Hence } \frac{dL}{dr} = 4\pi - \frac{2h}{r}$$

Setting this first derivative equal to zero and evaluating h we find

$$h = 2\pi r$$

That is, to obtain the shortest seam, the height of the tank should be made equal to π multiplied by the diameter.

In the same way we shall find for a tank with open top that

$$h = \pi r$$

Suppose, now, that the material of which the tank is made costs m dollars per square foot, and that the seams cost n dollars per linear foot to fabricate. Then the cost of material for a closed tank will be

$$m(2\pi r^2 + 2\pi rh) \text{ dollars}$$

and the cost of the seams for the same tank will be

$$n(4\pi r + h) \text{ dollars}$$

And the total cost t of the tank in dollars will be

$$t = m(2\pi r^2 + 2\pi rh) + n(4\pi r + h)$$

Differentiating this expression as before with respect to r, setting the derivative equal to zero, and evaluating h we find

$$h = \frac{2\pi r(mr + n)}{\pi mr + n}$$

as the relation between the height and the radius of the most economical tank of a given capacity.

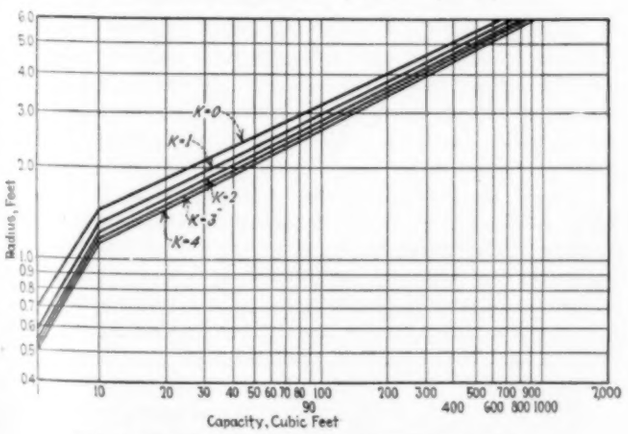


Fig. 1—Curves Showing Most Economical Radius for Open Lead Tanks

The horizontal scale from 1 to 10 has been shortened to save space, the vertical scale remaining unchanged. This causes the sharp break in the curves.

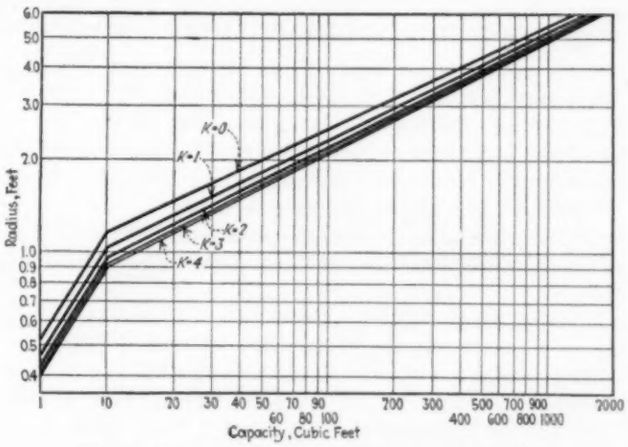


Fig. 2—Curves Showing Most Economical Radius for Closed Lead Tanks

The horizontal scale from 1 to 10 has been shortened to save space, the vertical scale remaining unchanged. This causes the sharp break in the curves.

This expression may be somewhat simplified by letting k represent the ratio between the cost of seam per linear foot and the cost of material per square foot ($k = n/m$). Then

$$h = \frac{2\pi r(r + k)}{\pi r + k}$$

The expression for the volume of the most economical tank with closed top then becomes

$$V = \pi r^2 h = \frac{2\pi^2 r^3(r + k)}{\pi r + k}$$

By using the same method we should find that the expression for the volume of the most economical tank with open top is

$$V = \pi r^2 h = \frac{\pi^2 r^2(r + k)}{\pi r + k}$$

Using these equations for the volumes, and inserting in them assumed values of r and k, curves may be plotted between V and r, one curve for each assumed value of k, so that when a tank is to be constructed, reference to the curves will show at once the radius to be used to produce the most economical tank of the capacity desired.

Using the Calculations

In practice, it will be found that k will vary between quite narrow limits, so that only a few curves need be constructed for a given type of tank.

In this article, curves have been constructed for lead tanks up to twelve feet in diameter with one longitudinal seam and with a circumferential seam where each head joins the cylindrical portion of the tank. For lead tanks it will be found that the value of k will practically always fall between zero and four, and that with present prices of lead and lead burner labor, the value of k will nearly always be less than unity.

Tanks of lead larger than twelve feet in diameter would very likely have a diametral seam in each head, and the formulas would have to be altered to fit this condition. The methods employed in this article may be applied to any type of tank of any material and any number of seams.

A few calculations will show the savings to be effected through the use of curves such as those here presented as opposed to a haphazard selection of the proportions of tanks.

Ammonium Sulphate from Gypsum

In a paper given before the 34th Annual Meeting, Michigan Gas Association, Mackinac Island, Mich., June 24-26, 1926, Harold W. Jackman gave an account of some tests carried out at Michigan University on the manufacture of ammonium sulphate from gypsum and ammonium carbonate. He said in part:

Gypsum will react with ammonium carbonate to form ammonium sulphate and calcium carbonate. The equation is

$$CaSO_4 2H_2O + (NH_4)_2CO_3 = (NH_4)_2SO_4 + CaCO_3 + 2H_2O$$

As gypsum is quite insoluble in water, it was thought that the reaction would proceed very slowly, but we were surprised to find that by using it finely ground the reaction was 95 per cent complete at the end of two hours. As ordinary concentrated ammonia liquor contains 50 to 75 per cent of its ammonia as carbonate and the remainder can be readily converted into carbonate, this reaction with gypsum should prove a very good process for manufacturing ammonium sulphate.

There are two processes for carrying this out, the direct and the indirect. In the indirect the ammonia is first scrubbed out of the gas by water and this crude liquor is then concentrated to a 15 per cent ammonia solution. The ammonia is then converted to carbonate by saturating it with CO_2. This can be done by circulating it slowly through a packed absorption tower countercurrent to a stream of flue gas drawn out of the stack. About 5 per cent of the total ammonia is carried away with the flue gases but this can be recovered by passing them through a solution of gypsum in water. All the hydrogen sulphide in the ammonia liquor is driven off, and the ammonia comes out of the bottom of the tower practically all in the form of carbonate.

The carbonate solution is next agitated with enough gypsum added to carry out the reaction. This gypsum cannot be added all at one time, or the whole mixture will set; but must be added little by little.

After this step, the mixture passes through a filter where the sludge of calcium carbonate is removed. The solution of ammonium sulphate is first distilled to drive off the remaining 5 per cent of uncombined ammonia, which is returned to the absorption tower. The solution is then evaporated, the ammonium sulphate crystallizing out. The crystals are then centrifuged and dried and the commercial product is the result.

The advantages of using gypsum over sulphuric acid are apparent. Gypsum is not corrosive, therefore no specially made apparatus is necessary. As to costs, one pound of SO_4 from 60 deg. Bé. acid at $13 per ton costs 1.02 cents, while from gypsum at $6 per ton it costs 0.65 cent. On each ton of ammonium sulphate the saving then equals $4.48.

In the direct gypsum process, water is saturated with gypsum and circulated countercurrent to the gas flow through a packed absorption tower. Ammonia and carbon dioxide are absorbed from the gas by the equation:

$$2NH_3 + CO_2 + H_2O + CaSO_4 = (NH_4)_2SO_4 + CaCO_3$$

Calcium carbonate sludge is occasionally drawn off and the solution of ammonium sulphate is continually resaturated with gypsum and recirculated until a strong solution is built up. This solution can be partly drawn off periodically and evaporated cheaply by exhaust steam in an open steam jacketed drier.

Another possibility would be not to evaporate at all and to allow the ammonium sulphate to crystallize out with the sludge, and, all drawn out together along with some gypsum, sell the mixture as fertilizer of the approximate composition: Ammonium sulphate 54 per cent, calcium carbonate 40 per cent, gypsum 6 per cent.

To try out this latter method a plant was constructed at Battle Creek to handle 100,000 cu.ft. of gas per day. This was first installed just after the tar extractor which gave a fairly clean gas at 100 deg. F. with 165 grains of ammonia per 100 cu.ft. The ammonia removed was almost independent of the gas velocity, but depended on the temperature of the gas and the volatile ammonia content of the gypsum solution. At a temperature of 80 deg. F. with 0.2 per cent volatile ammonia, 79 per cent of the ammonia was removed from the gas. This left 34 grains per 100 cu.ft. with gas at 4,000 cu.ft. per hour and 42 grains at 8,000 cu.ft. per hour.

Next gas was taken from the inlet to the primary cooler. This gas contained 265 grains of ammonia per 100 cu.ft. and under the same conditions all but 37 grains were removed. This proved the amount of ammonia left in the gas to be independent of the initial concentration and to depend chiefly on the temperature and per cent of volatile ammonia in the scrubbing solution.

The temperature can be controlled by cooling coils and the volatile ammonia can be easily kept low by blowing a small amount of CO_2 or stack gas into the solution. The remaining few grains of ammonia can be removed from the gas in a small fresh water scrubber, and this liquor added to the gypsum solution and subsequently evaporated, thus cleansing the gas and recovering all the ammonia.

With this complete recovery of ammonia and with the cheapness and simplicity of the installation, it is believed that the direct gypsum process should produce a good quality of ammonium sulphate more cheaply than any of the familiar methods.

Government Warns of Fraud In Radioactive Waters

The alleged medicinal efficacy of slightly radioactive waters and other slightly radioactive preparations has been found to be much misrepresented, according to the Bureau of Chemistry, which has made a nation-wide survey of such materials.

Only 5 per cent of the products analyzed and claimed to be radioactive contained sufficient radium to entitle them to consideration as therapeutic agents and then only in certain limited conditions. Highly exaggerated claims obviously designed to mislead the purchaser are being made for many of the products which contain little or no radium.

One of the samples examined consisted of a short glass rod coated on one end with a yellow substance and enclosed in a glass bulb. The bulb is designed to be hung over a bed and, according to the claims of the inventor, causes dispersion of "all thoughts and worry about work and troubles and brings contentment, satisfaction and body comfort that soon results in peaceful, restful sleep."

Action will be taken under the Federal Food and Drugs Act against shipments of the alleged radioactive products which are falsely or fraudulently misbranded under the terms of that act. A warning regarding the indiscriminate use of those few products which are highly radioactive is also sounded by the Bureau.

Contributions of Science to the Rubber Industry

Accelerators, anti-oxidants, reinforcing pigments and reclaimed rubber are notable contributions of chemical technologist

By L. E. Weber
Consulting Rubber Technologist, Boston

FIFTEEN years ago chemists were not a generally accepted part of the rubber industry, and those that were employed did not rise much above the dignity of routine analysts. But the last decade has seen a marked change in the attitude of the manufacturer, and it is now exceptional not to find the rubber chemists a vital part of the factory organization. As an illustration of what science and technology has accomplished in the rubber industry, I should like to review four developments that have justified fully the present confidence of the manufacturer in the application of chemistry to his business.

The first development that I call to your attention is that of accelerators. As you know, the pivotal operation in the manufacture of rubber goods is vulcanization. This operation consists in subjecting the rubber to temperatures varying from as low as 250 deg. F. to as high as 315 deg. F., or even higher. The average vulcanization temperature is about 290 deg. F., and is usually carried out in a cylindrical chamber, known as a vulcanizer, which is capable of being sealed hermetically, and into which steam is admitted. The article to be vulcanized is sometimes confined within a mold and at other times upon the surface of a shaper. Thus, an automobile tire is vulcanized within a mold, and an inner tube is vulcanized while stretched slightly over the surface of a mandrel acting as a shaper.

The time required for vulcanization is appreciable. Thus, a few years ago it required from two to three hours to vulcanize an average automobile tire, and not much less time was required for the vulcanization of an inner tube. The accelerator is a substance which is added primarily for the purpose of reducing this period of vulcanization, and with the aid of the accelerator it is possible to vulcanize tires and tubes in approximately one-third of the time formerly required.

Economic Significance of Accelerators

It is obvious that with a given amount of equipment the possible output is in almost direct proportion to the time of vulcanization. By means of suitable accelerators it is possible to vulcanize in approximately one-third of the time which would be required in the absence of the accelerator, and this makes it possible for the rubber manufacturer to need approximately only 40 per cent of the equipment which he would need did he not have the accelerator. It is herein that the large saving of the accelerator lies. It is conservatively figured that the tire industry for molds alone spends $10,000,000 a year. The industry would have to spend at least two and a half times as much for molds did it not have efficient accelerators. Comparable savings have been possible in capital expenditures for vulcanizers, which, although simple in principle, are expensive to install and equip with the elaborate devices for controlling and maintaining uniformity of heat conditions within them.

There is a second advantage in the use of accelerators. Not only do they reduce the time of vulcanization, but they make the vulcanized product much less susceptible to overvulcanization. Ordinarily, if an article is vulcanized either for a longer period of time, or at a higher temperature than is necessary, so-called overvulcanization results, and this is very prejudicial to the life of the article. The accelerator exerts a braking or retarding action once vulcanization has been obtained, and thereby decreases the susceptibility of the rubber to overvulcanization, should either the time or temperature be in excess of the prescribed amount. Strictly speaking, of course, these irregularities ought not to take place, but they are exceedingly difficult to eliminate in commercial operations.

A third advantage of the accelerator is that it greatly enhances the properties of the vulcanized article; not only by adding toughness and tensile strength, but in that it renders the finished product much less susceptible to oxidation, and thereby prolongs the natural and active life of the article in question.

Increasing Life of Rubber With Anti-Oxidants

It is a remarkable fact that as a result of vulcanization the physical properties of crude rubber should be greatly improved, but that its stability is impaired. Crude rubber can be stored for many years without undergoing any observable change; in other words, the material is highly stable. This is not so with vulcanized rubber. The deterioration which vulcanized rubber undergoes as a result of natural aging is slow, but it is nevertheless appreciable.

The deterioration of vulcanized rubber is thought to be due to oxidation, and much evidence has been accumulated to substantiate this theory. The inconsistency of the theory is the much greater stability of crude rubber, which is more unsaturated than is vulcanized rubber, and which accordingly should be more susceptible to combination with oxygen.

Corroborating the oxidation theory as explaining the deterioration of vulcanized rubber is the fact that this deterioration can be accelerated greatly by substances that are known to act as oxygen carriers. Notorious in this respect are the salts of copper and manganese, which have a marked oxidizing action upon rubber, either crude or vulcanized. Since substances are known which accelerate oxidation, presumably catalytically, it is only natural that effort should have been made to discover substances which retard oxidation, and within the last few years notable accomplishments have been made in this field.

Substances that retard the oxidation of rubber, or in less technical language, increase its aging, have been styled anti-oxidants. Substances such as benzidene, beta-naphthol and certain of its derivatives have anti-oxidant properties. Even more marked are certain condensation products of aromatic amines and aldehydes. The addition of one or two per cent of these substances will actually double, if not triple, the natural life of a rubber compound. The use of these anti-oxidants furthermore makes a rubber compound much less susceptible to the deteriorating action of continued high temperature. The deterioration of rubber being presumably one of oxidation, it is only to be expected that deterioration increases with the temperature.

Address before New England Association of Chemistry Teachers, Springfield, Mass., May 15, 1926.

Under these conditions the use of the anti-oxidant has been found to be of the greatest benefit, in that it has been possible with its aid to increase very greatly the life of a rubber compound exposed to continued high temperatures.

The properties of rubber which have made it of such unique value are, in the first place, its plasticity in the unvulcanized state, because this enables the material to be manipulated and shaped; secondly, the elasticity of the vulcanized product, and, finally, the potential abrasive resistance of the vulcanized product. Vulcanized rubber, of itself, is not highly resistant to abrasion; but if suitable ingredients are incorporated into the rubber, prior to vulcanization, its abrasive resistance is unique. The substances which have the property of increasing the abrasive resistance of rubber are known technically as reinforcing agents.

The reinforcing agent which has been used by the rubber manufacturer the longest in point of years is zinc oxide. You may recall that up to within about 10 years ago nearly all automobile tire treads were white. This was because they contained large amounts of zinc oxide; in fact, the old white tire tread contained approximately equal parts of rubber and zinc oxide, the latter predominating slightly. In addition, of course, the necessary amount of sulphur was present. About 10 years ago the color of automobile tire treads changed suddenly from white to black. This change was not prompted by any dictates of fashion, but because it had been discovered that one of the oldest known black pigments had a very strong reinforcing action when added to rubber in suitable quantities; in fact, it produced a product which had almost double the abrasive resistance of that obtainable with zinc oxide. The black pigment, which has this remarkable property of increasing abrasive resistance, is carbon black, also known as gas black. Carbon black, as you know, results from the incomplete combustion of natural gas, the material being deposited upon a metallic surface which is in contact with the gas flame. It should not be confused with lamp black, which is produced by the incomplete combustion of an oil or resin, and collected as a smoke in settling chambers. Carbon black is the pigment used in the manufacture of printers' ink.

It is the practice today to incorporate anywhere from 30 to 40 per cent of this material, based upon the rubber present. Its use has become standard in all cases where high toughness and abrasive resistance is desired, since no other material has been found even to approach it in this respect. The reinforcing action of carbon black is truly remarkable.

Relation of Tire Mileage to Reinforcing Agents

In order to give numerical expression to the extent to which a rubber compound reinforced with carbon black resists abrasion, let us consider an automobile tire tread. As you know, the average thickness of a tire tread is approximately one-quarter of an inch. It is not unusual for a tire to deliver 15,000 miles before the tread is worn down. A simple calculation will show that in running this distance the tire has made approximately 10,000,000 revolutions; in other words, it has made 10,000,000 frictional contacts with the road under a load of 500 lb. (if we assume that the average automobile weighs 2,000 lb.), and the total thickness of the material that has withstood this huge number of frictional contacts is only a quarter of an inch. I think you will agree that the abrasive resistance of rubber is unique, but a large share of the credit must be given to the carbon black.

Reclaiming Rubber Is Big Industry

The desire to use again the rubber in discarded rubber articles is almost as old as the industry itself. So-called reclaiming processes made their appearance at least 75 years ago; but the methods employed today in the manufacture of reclaimed rubber are of more recent origin, being developments of the last 25 years.

In order to appreciate the principles involved in the manufacture of reclaimed rubber, let us consider once again the essential difference in the properties of crude and vulcanized rubber. This difference may be stated briefly by defining crude rubber as a plastic material without appreciable elasticity, while vulcanized rubber is a non-plastic material of high elasticity. Accordingly, the fundamental problem in reclaiming vulcanized rubber is the conversion of the non-plastic vulcanized rubber into a plastic mass, which will become again highly elastic upon revulcanization. The belief is widely held that if at the same time it were possible to remove the combined sulphur from the vulcanized rubber, enhancement in the value of the reclaimed rubber would ensue. I am inclined to doubt this, but in any case the matter is not of immediate interest for us because none of the reclaiming processes do remove even a portion of the combined sulphur. They merely convert the waste rubber into a plastic mass.

Reclaimed rubber is seldom used by itself; that is to say, it is nearly always used in admixture with some new rubber. It is not correct to regard reclaimed rubber as an adulterant or as a cheapener, since in the majority of cases its use fulfills a definite function and purpose. The importance of reclaimed rubber to the rubber manufacturer can best be judged by the fact that the American rubber industry this year will consume approximately 400,000 tons of rubber. The American reclaiming industry will produce at least 200,000 tons of reclaimed rubber. It is unnecessary then to point out what an important part reclaimed rubber plays in the industry, and what a vital factor it is in the conservation of available crude rubber supplies.

Plant Biology of Rubber Important

Of future developments, the problem of synthetic rubber will doubtless come to your minds quickly, in view of a possible future shortage of crude rubber. The synthesis of rubber is undoubtedly one of the most fascinating problems which the chemist could select for attempted solution; but its technical importance, to my mind, is completely overshadowed by a problem in the agricultural chemistry of rubber; or, let us say, in the plant biology of rubber. I have reference to the question of increasing the yield of rubber per tree. Under present practice the annual yield of rubber per tree is not much in excess of 4 lb. You may recall that at the inception of the beet sugar industry, the amount of sugar in the beet was approximately 2 per cent. The plant biologist has succeeded in increasing this percentage ninefold. It is probably fantastic to imagine that a percentage increase of a comparable magnitude is possible in the case of the rubber tree. However, the mere doubling of the yield would be an accomplishment without parallel, in my opinion, in its effect and results on the rubber industry of the world.

Selling Nitric Acid to Many Industries

How the most important of the mineral acids is marketed and used in producing many of the basic articles of commerce

By William M. Rand

Treasurer and Sales Manager, Merrimac Chemical Co., Boston, Mass.

NITRIC ACID is a clear, transparent, strongly corrosive liquid, colorless in its pure state, but slightly yellow to reddish brown in the commercial grades. It is well named "aqua fortis" (strong water), as one may realize when its suffocating fumes are breathed. Pure nitric acid is about half again as heavy as water.

Several grades are now placed upon the market. The technical, which is usually from 36 to 44 deg. Baumé, aqua fortis 41½ deg. (65.67 per cent HNO_3), U.S.P. and fuming (86 per cent HNO_3). The usual commercial strengths are 30 deg. to 42 deg. Baumé. For the most part the product is purchased according to its Baumé test. The following table gives the percentage of HNO_3 and the weight in pounds per gallon for the common commercial strengths:

Deg. Baumé	Per Cent of HNO_3	Pounds per Gallon
36	52.30	11.09
38	56.52	11.30
40	61.38	11.51
42	67.18	11.74

There is some confusion in the nomenclature of nitric acid. Nitric acid, aqua fortis, pale aqua fortis (straw color), and red nitric acid are all nitric acid with different degrees of impurities. Chemically pure nitric acid is, as the name implies, pure. Aqua fortis by some is considered the pure white nitric acid and by others the yellowish or straw-colored acid. Red nitric acid is of lower grade, generally containing oxides of nitrogen, chlorine, iron and other impurities. These may be removed by bleaching to produce white nitric acid, which contains no lower oxides nor chlorine, is free from color and has only a trace of iodine; in other words, it is practically chemically pure nitric acid. Many customers are particular in regard to a certain impurity. Perhaps for one it is chlorine, for another iron, or lower oxides of nitrogen.

Special Precautions for Shipment

As nitric acid is a dangerous article to transport, it is necessary to give a great deal of care to the methods of shipment. If the acid leaks from its container it may set fire to wood, straw, cloth or any organic matter with which it comes in contact. Because of its corrosive nature and poisonous fumes nitric acid is always unpleasant to handle when it gets loose. For commercial uses the acid is shipped in glass or stoneware carboys. It also may be shipped in steel tank cars, when mixed with a proper proportion of sulphuric acid. There must be at least 5 per cent of sulphuric acid and not over 3 per cent of water in order to make the storage in iron or steel tanks safe. The precautions taken by the railroad companies in shipping this acid are severe and it is not allowed to be shipped in carboys unless the carboys are packed with some material that will not be liable to combustion if the carboy breaks. Formerly they were packed with rubber but they may now be packed with steel wool. Of late a special type of carboy has been put upon the market which is regarded as the safest in use for the shipment of nitric acid. While ordinary carboys weigh from 90 to 100 lb., the new Smith carboy weighs 75 lb. It is cushioned by a line of corks, keeping the bottle firmly in the case and giving sufficient resiliency to stand the most drastic tests given by the Bureau of Explosives to meet carboy regulations for the shipment of acid. Nitric acid has a net weight of about 145 lb. per 13-gal. carboy. The old carboy made a gross weight of approximately 240 lb. and occupied six and eleven-twelfths cubic feet. The new carboy makes a gross weight of 215 lb. Recently there has been considerable development in the use of aluminum for the shipment of strong nitric acid. This has not been developed for the weaker commercial acid. Interstate Commerce Commission regulations call for a display of the white label of "dangerous acid" on all nitric-acid shipments.

MARKETING

Each year 80,000 tons of nitric acid goes to market in the United States and from it is produced literally thousands of articles used in our daily lives. Dozens of different grades and strengths of acid must be made to meet the requirements of these many uses. Sometimes these are only the arbitrary demands of long established trade practice. Sometimes exacting specifications are necessary in order to produce a product of exceptional properties. And, since nitric acid is not easily handled in commerce, the railroads and the government have provided stringent regulations for its transport. These are some of the important characteristics discussed authoritatively by Mr. Rand in the concluding article in his series on the "Marketing of the Mineral Acids."

CHEMICAL PRODUCTS

History of the Industry

The first record of the manufacture of nitric acid was by Geber, a chemist who lived from 750 to 800 A.D. He made it then by heating potassium nitrate, copper vitriol and alum. Geber called it "aqua fortis" or "strong water." The nitrate-oil of vitriol method of making nitric acid was first mentioned by Basil Valentine in the fifteenth century; he stated that the process was by no means a new one then. In 1864 Carter & Scattergood first manufactured the acid in the United States in Philadelphia. From early days to the present there has been little change in the basic process of manufacture. The next decade, however, will doubtless write

new pages in the history of nitric acid, as the synthetic process supersedes the older method.

Method of Manufacture—The process of manufacture of nitric acid is changing. For many years the acid has been made by the treatment of nitrate of soda with sulphuric acid. Another process, not commonly used, is that of oxidizing ammonia obtained from the waste liquors of gas houses and byproduct coke ovens. Recently progress in the fixation of nitrogen has made available cheap supplies of synthetic ammonia. The oxidation of synthetic ammonia would seem to be the coming method of nitric-acid production. At least there need be no uneasiness on account of a shortage of raw materials for the manufacture of nitric acid. Nitrate of soda originates in Chile and that country controls a supply which can care for the demand for decades to come. If the supply of nitrate were cut off and for any reason the material could not be obtained from Chile, nitric acid could be made by the ammonia-oxidation process. In fact, Germany is now producing the greater part of its acid in this way.

Manufacturing Points—There are fifty odd establishments for the manufacture of nitric acid in the United States. These establishments produce approximately 80,000 tons of 100 per cent acid per year. They are located as follows:

Massachusetts	1	Illinois	5	Alabama	1
New York	6	Michigan	3	Montana	1
New Jersey	11	Wisconsin	1	Colorado	2
Pennsylvania	8	Missouri	2	Washington	1
Ohio	2	Kansas	1	California	6
Indiana	1	Maryland	1		

The progress of the industry since 1914 is shown in Table I, which summarizes the statistics compiled by the Census of Manufactures in each census year since that date.

Table I—Production of Nitric Acid in the United States, 1914-23

	1923	1921	1919	1914
Number of establishments	55	56	59	52
Total production, tons	113,116	57,887	86,992	78,589
For sale, tons	21,759	8,300	19,436	14,685
Value reported	$2,741,370	$1,317,918	$2,976,095	$1,591,625
Average per ton	$126	$159	$153	$108
Production according to strength, tons				
36 deg. Bé	4,928	643	Details not shown prior to 1921	
38 deg. Bé	10,758	3,836		
40 deg. Bé	74,682	40,229		
100 per cent	21,948	12,935		
Chemically pure	800	244		
Total production, basis 100 per cent HNO_3				
Tons	77,633	40,475		
Production by industries, tons				
Explosives	65,595	34,376	48,588	Not shown prior to 1919
Chemicals, n.e.s	33,602	13,271	18,962	
Sulphuric, nitric and mixed acids	13,919	10,213	18,831	
Other industries	.....	27	611	
Production by States, tons				
Illinois	4,709	2,301	5,051	
New Jersey	44,804	23,846	28,918	
New York	6,103	2,841	4,212	
Pennsylvania	15,606	7,392	5,083	
California	6,208	4,029	.....	
All other States	35,686	17,478	43,728	

Byproducts—In the manufacture of nitric acid by the nitrate process there is one byproduct, nitre cake (sodium acid sulphate). It is a strongly acid crystalline solid, varying from white to yellow in color. Perhaps it could be called "solid sulphuric acid," as it contains about 35 per cent free H_2SO_4. It is used in the manufacture of artificial silk, in dyeing and also in chemical manufacture where it may be neutralized to make sodium sulphate which finds broad usage in the glass and paper industries.

The prices of nitric acid change a great deal in accordance with the methods of packing. For the purpose of comparison there follows the price of nitric acid in carboys, carload lots, 40 deg. Baumé, for the past eleven years. Of course prices vary according to the strength and in the case where nitric acid is bought in tank cars in different mixtures with sulphuric acid, the common practice is to give certain prices per unit of 100 per cent HNO_3 and 100 per cent H_2SO_4. In that way whatever mixture the customer wishes can readily be given a price, according to the amount of each ingredient.

Table II—Prices of 40-Deg. Nitric Acid in Carloads, Carboys per Pound

		Cents			Cents
	1915	6½	Oct.	1918	8½
Oct.	1915	7½	Oct.	1919	7
Oct.	1916	6	Jan.	1919	8½
Nov.	1916	5?	Jan.	1921	8-15
Apr.	1917	7½	June	1921	7
May	1917	8	May	1923	6
Nov.	1917	9½		1924	6
July	1918 (estab. by the Gov't.)	8½		1925	5½

Nitric acid has a reputation for *action*. Its principal use is in explosives. Nitric acid mixed with sulphuric acid is employed in nitrating cotton, paper or other cellulose to make nitrocellulose, nitroglycerine, smokeless powder, picric acid, T.N.T. and many high explosives. With a little change in the nitration we produce the pyroxylin plastics used in the manufacture of combs, toys, dressing table sets and innumerable other articles. Recently a development has arisen in the manufacture of pyroxylin lacquers to take the place of paints and varnishes for automobiles, furniture and interior decoration. This industry is in its infancy and promises to increase tremendously the production of nitric acid. Nitric acid to the jeweler is his most important chemical. The electroplater finds use for its corrosive powers. The metal manufacturer cleans brass, copper and other metals with it. Its strong corrosive action is useful to printing and photo-engraving. The chemical industry uses it to manufacture ammonium nitrate and in the chamber process of manufacturing sulphuric acid where nitric acid gives its help by accelerating the oxidation of sulphurous acid. Other chemical uses are as a reagent in general organic synthesis, in the manufacture of nitrobenzol and many other intermediates. It is used in the preparation of gold and silver, as a solvent for some metals, in the gilding of brass, in the refining of precious metals, in making Berlin Blue for the paint and varnish manufacturers, in the manufacture of nitrate of iron for dyeing silk black.

Chem. & Met. in its third Annual Review Number roughly estimated the distribution of the 80,000 tons of nitric acid manufactured in the United States as follows: Approximately 70 per cent for explosives, 20 per cent for pyroxylin plastics and lacquers, 5 per cent for chemicals and dyes and 5 per cent for all other uses.

Mankind is greatly indebted to this chemical, although little does the average man realize it in his busy everyday lift, as he enjoys the luxuries of his automobile finished with pyroxylin lacquers and upholstered in artificial leather. Little does he think of nitric acid as the scent of burnt powder adds to the thrills of his hunting trip or as he witnesses blasting for new buildings or roads; as he looks through the myriad of alluring magazine pictures or as he examines his watch for accurate time. Thousands of objects used in our daily life are so much "taken for granted" that we little think how they are made and what part is taken in their manufacture by the fuming, poisonous, corrosive "strong water." Man has harnessed the virulence of nitric acid to make his liivng conditions easier.

Marketing Tartaric and Citric Acids

Although primarily highly refined food products these chemicals also find important industrial uses

By S. D. Kirkpatrick
Associate Editor, *Chem. & Met.*

Editor's Note. It is significant that the principal organic acids of commercial importance from the standpoint of human consumption are those naturally present in fruits. The "acid of grapes" and the "acid of citrus fruits" have had long established use in beverages, confections and other food products. With their derivatives, they are widely used in medicine. Industrial uses have declined somewhat with the advent of cheaper substitutes but for certain applications tartaric and citric acids are still essential. Both have been prepared synthetically by the fermentation of other substances, but the natural fruit materials, largely imported from abroad, are still the principal source. Thus international as well as purely domestic conditions have affected the marketing characteristics of these chemicals which are discussed in this concluding section of the article on the "Marketing of Organic Acids."

Tartaric Acid

In the form of cream of tartar and as an important constituent in baking powder, tartaric acid is primarily a food product. As in the case of citric acid, with which it is competitive in certain uses, Southern Europe is the chief source of its raw material.

Tartaric acid, "acid of grapes" is the most important of the organic acids used in food products. It is a white solid sold in three commercial forms: Crystalline, granular and powdered. Commercial tartaric acid is a highly refined product meeting the various requirements of the U. S. Pharmacopoeia, chief among which is a minimum content of such impurities as oxalates, sulphates and the heavy metals. The U.S.P. product must contain not less than 99.5 per cent of the pure acid $C_2H_2(OH)_2(COOH)_2$ and on ignition yield not more than 0 05 per cent of ash.

Chemically pure tartaric acid, used principally as a laboratory reagent, is further refined than the U.S.P. grade to meet the following standards of purity:

SO_3	.02%	Ca	.013%
Cl	Nil	Fe	Nil

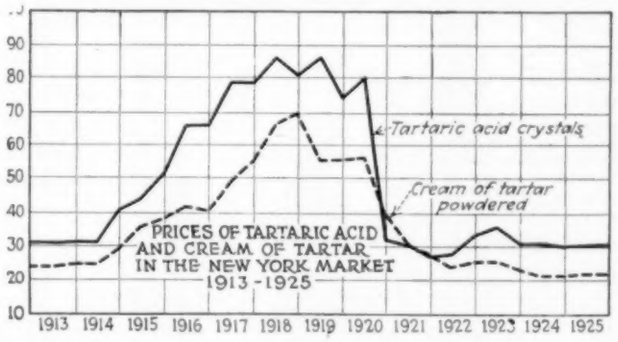
Tartaric acid, crystalline, granular or powdered, is shipped by the domestic manufacturers in 100-, 250- and 400-lb. bbls. the standard being the 250 lb. The C.P. grade is packed in smaller containers such as 5-, 25- and 50-lb. boxes and is often repacked into still smaller cartons by the dealers and jobbers. There are no I.C.C. regulations for packing and shipment.

Cream of tartar (potassium bitartrate) is the form in which a considerable proportion of tartaric acid is consumed. Although chemically a derivative of the acid, cream of tartar is actually obtained directly from the crude tartar materials. In fact, under some conditions of operation tartaric acid is regarded as a byproduct of cream of tartar manufacture. It, too, is a highly refined product conforming to the U.S.P. requirements of purity. It is packed and handled in the same way as tartaric acid.

The annual requirement of the United States for tartaric acid is probably 6 to 8 million pounds, and in addition about an equal quantity of cream of tartar is used. There is some variation in the demand for these materials due presumably to the competition of other chemical products. The most important use of both is in the manufacture of tartrate baking powders, which are generally regarded as the most wholesome from the standpoint of health and purity. In some baking powders mineral-acid derivatives are substituted for cream of tartar and tartaric acid—among them being calcium acid phosphate and the various alums. The second largest use for tartaric acid is in the manufacture of effervescent medicinal preparations, soft drinks and confections. There has been a considerable increase in these uses in recent years as tartaric acid has replaced the more expensive citric acid, but the two products are not generally regarded as interchangeable. Cream of tartar is used to some extent by the housewife in cooking, and on a large scale in commercial bakeries.

It is estimated that more than 90 per cent of the total consumption of tartaric acid and cream of tartar is in food and medicinal products. That which is used by the various industries is widely distributed but some of the principal outlets include the manufacture of dyes and chemical derivatives. Tartrazine, manufactured in the United States by 5 producers is the principal dyestuff in which tartaric acid is used. Of the chemical derivatives tartar emetic (antimony potassium tartrate) and Rochelle salts (sodium potassium tartrate) are the best known, but other compounds such as bismuth tartrate and dibutyl tartrate are of commercial importance.

Prices of tartaric acid and cream of tartar are generally quoted on the New York basis but the manufacturers maintain stocks at Chicago and St. Louis. Prices in these centers are usually ½c. to 1c. per lb. more on acid, and 1c. to 1½c. per lb. more on cream of tartar.



It will be observed from the accompanying chart that the prices of tartaric acid and cream of tartar while mounting to high levels during the period 1914 to 1920, have since receded to pre-war levels. High and low prices of tartaric acid during recent years have been as follows:

Year	High	Low	Year	High	Low
1918	$0.92½	$0.77	1922	$0.31	$0.24
1919	.86	.65	1923	.37½	.26
1920	.80	.60	1924	.28	25½
1821	.48	.25	1925	.29	.27

Tartaric acid and cream of tartar are manufactured from argols, crude tartar and wine lees, which are byproducts of the wine industry. The principal sources of these raw materials, therefore, are the wine-produc-

ing countries of Southern Europe, particularly Italy and France. The United States produced some tartar materials prior to prohibition, and a very small quantity is still made by the grape juice industry. The American producers of tartaric acid and cream of tartar, however, import argols, crude tartar, wine lees and some calcium tartrate from Italy and France and convert these materials into the highly refined finished products in chemical plants in this country. At the present time tartaric acid is produced in two plants located in Brooklyn, N. Y., one in Cleveland, Ohio, and a fourth in California. U. S. Census figures for production of tartaric acid and cream of tartar follow:

Production of Tartaric Acid and Cream of Tartar, 1914–1923

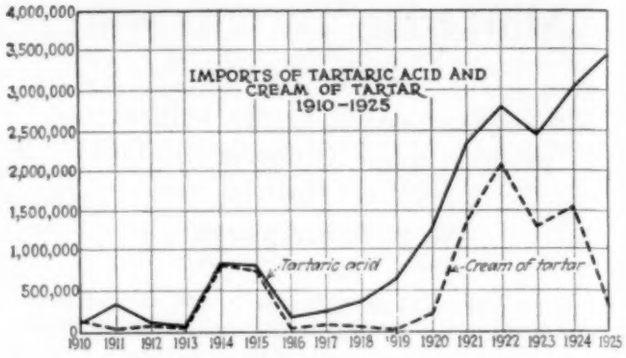
Tartaric Acid	1923	1921	1919	1914
Number of Establishments	4	....	4	....
Pounds	5,868,000	....	5,312,965	....
Value	$1,544,431	....	$4,262,376	....
Average per lb.	$0.26	....	$0.80	....
Cream of Tartar				
Number of Establishments	4	7	6	8
Pounds	5,971,186	5,778,731	4,854,550	12,696,120
Value	$1,746,363	$1,630,150	$2,620,351	$3,124,958
Average per lb.	$0.29	$0.28	$0.54	$0.25

Foreign competition in tartaric acid and cream of tartar is largely an after-war development. It was started, to be sure, in 1914 when the duty was reduced by the Tariff Act of 1913, but it is only since 1920 that imports have had a dominating influence on the American market. The principal competition comes from Italy although a recent combination of the German tartaric acid producers (see *Chem. & Met.*, Jan., 1926, p. 61) has become a formidable factor in the international situation.

Imports of Tartaric Acid and Cream of Tartar, 1908–1923

	Tartaric Acid		*Cream of Tartar*	
Year	Pounds	Dollars	Pounds	Dollars
1908	57,718	11,355	12,242	2,083
1909	124,774	23,245	6,846	1,073
1910	16,249	2,854	90	13
	88,208	15,744	116,187	9,899
1911	331,538	72,204	23,433	3,401
1912	105,311	24,116	82,980	16,300
1913	78,942	15,747	66,718	11,797
1914	22,076	4,932	436	101
	826,499	198,918	812,421	156,886
1915	820,105	273,880	764,868	166,922
1916	198,873	84,373	38,588	13,479
1917	268,180	162,478	98,609	28,488
1918	384,262	231 099	68,586	16,067
1919	654,736	447,571	23,652	10,879
1920	1,367,103	850,369	218,887	83,903
1921	2,317,944	706,733	1,337,033	306,674
1922	2,792,163	648,459	2,083,647	395,746
1923	2,438,129	594,201	1,280,209	194,084
1924	2,997,233	626,266	1,531,226	165,471
1925	3,472,252	690,979	315,652	43,525

In the Tariff Act of 1909 both tartaric acid and cream of tartar were dutiable at 5c. per lb., but this rate was reduced to 3½c. per lb. in 1913 for the acid, and 2½c. per lb. for the salt. The Tariff Act of 1922 again increased the duty to 6c. per lb. in the case of tartaric acid, and 5c. per lb. in the case of cream of tartar and Rochelle salts. In spite of these duties, however, there has been an unprecedented increase in imports. Acting on a petition of one of the domestic manufacturers, the United States Tariff Commission on March 4, 1926, ordered an investigation of the cost of producing tartaric acid and cream of tartar in this country and abroad. If this differential is as represented, the manufacturer has asked that the duties be increased by 50 per cent—the maximum permissible under the flexible provisions of the Tariff Act.



Citric Acid

As a byproduct of the lemon growing industry, citric acid assumed international interest as the Californian producers began to compete with the long established Sicilian industry. The latter has dominated world trade through its control of raw materials.

As implied by its name, citric acid is the characteristic acid of the citrus fruit. That produced commercially is obtained principally from lemons and limes and enters commerce as colorless, translucent crystals, or as a white powder. Chemically citric acid is a tribasic organic acid corresponding to the formula $C_3H_4(OH)(COOH)_3.H_2O$.

Since the great bulk of citric acid is for human consumption, it is a highly refined product meeting the rigid specifications of the U. S. Pharmacopoeia which require a content of not less than 99.5 per cent of the pure acid and the practical absence of heavy metals and oxalic, tartaric and mineral acids or their salts. Ash must be less than 0.05 per cent.

Citric acid crystals are shipped in paper or cotton lined wooden barrels containing 100, 112 or 230 lb. The powder is packed in 100- or 112-lb. kegs or in 200-lb. bbls. Both kinds are sold in 5-, 25- and 50-lb. boxes. Chemically pure citric acid for reagent use is sold in cork-stoppered bottles holding ½, 1 lb. and 5 lb. Typical specifications for this grade are:

Solution in H_2O	Clear
H_2S metals	Nil
Heavy metals	.0001%
Chlorine	.0002%
Non-Volatiles	.04%
SO_3	.0034%
Ca	Nil

Consumption of citric acid in the United States is in the neighborhood of 6,000,000 lb. per year which represents an increase of about 2,000,000 lb. during the past 5 or 6 years. Its principal use is in the manufacture of effervescent proprietary compounds sold for medicinal purposes. Soft drinks, fruit-juice preparations and flavoring extracts are also important outlets for citric acid. It is used in preparing a number of chemical derivatives such as the ammonium, potassium and sodium citrates which are used in medicine or have industrial applications such as in photography or as laboratory reagents.

As in the case of most chemicals, New York City is the chief center of distribution although manufacturers' stocks are maintained in certain other large cities of the country. There are no enforced restrictions on packaging and shipment, but the fact that citric acid is slightly hygroscopic makes it desirable to line the containers with moisture-proof bags.

Prices are usually quoted f.o.b. New York City, manufacturer's plant or warehouse. For the most part citric acid has had a comparatively stable price history although following the general trend shown by other chemical commodities. Prior to 1913 the average price for a number of years had been 40c. per lb. For 1914, 1915 and 1916 prices held steadily at about 55c., but increased during the next three years to a maximum of $1.25 in December, 1918. Since that time there has been a considerable decline in prices as is indicated by the accompanying table:

Prices per lb. of Citric Acid Crystals at New York, 1918-1926

Year	High	Low	Year	High	Low
1918	$1.25	.71	1922	.50	.42
1919	1.25	.55	1923	.52	.46
1920	1.20	.60	1924	.48	.45½
1921	.55	.42½	1925	.46	.45½

Domestic Citric Acid Industry

Although the United States produces about five-sixths of the domestic consumption of citric acid, a large proportion of this output is made from citrate of lime imported from Southern Europe. There is a growing domestic industry being developed along the Pacific Coast to utilize the byproducts of the California citrus industry, but at present this output is probably less than a fifth of the total consumption.

The eastern branch of the industry consists of three plants located in New York City, Philadelphia and Maywood, N. J. The raw material used is either calcium citrate imported chiefly from Sicily, or the concentrated juices of lemons and limes brought in principally from the Dominican Republic and other of the West Indies. Citrate of lime exported from Sicily is controlled by the Camera Agrumaria, an agency of the Italian Government that periodically fixes prices and allots shipments. This control has had its effect on the industry all over the world, and doubtless contributed to the general stability of prices. The California industry[1] developed as a means of utilizing the so-called "cull" lemons is, of course, not under the domination of the Sicilian producers. Competition from American sources has doubtless affected the price structure of the industry in spite of the fact that the California producers are handicapped by a much smaller output and higher cost for labor and materials. Better citrus culture in the United States gives a smaller proportion of inferior fruit, which also limits the extent of the byproduct industry.

The most recent domestic development is the commercial production of exceptionally pure citric-acid solutions by the controlled fermentation of sugar. At the present time a demand exists in several industries for a very pure citrate of lime and as this material has not previously been obtainable at commercial prices, the fermentation process has been largely used for its commercial production.

Census statistics for the production of citric acid in the United States are given in the accompanying table.

Production of Citric Acid in the United States, 1914-1923

Year	Number of Establishments	Quantity (In pounds)	Value	Average value per lb.
1914	3	2,657,840	$1,516,336	$0.57
1919	6	3,163,676	3,047,371	.96
1921	5	3,849,789	1,913,774	.50
1923	6	5,689,473	2,829,306	.50

[1] An excellent article on the production of citric acid in the cooperative plant of the California Fruit Growers Exchange at Corona, Calif., was published in *Chem. & Met.* Oct. 29, 1923.

Foreign competition in the citric acid industry has been felt most since the War, for prior to 1914 imports had rarely exceeded 200,000 lb. per year and had usually been considerably less. Following a 2c. reduction in the import duty on citric acid and the imposition of a tariff on calcium citrate, the imports of citric acid increased to 651,739 lb. in 1914, and to 722,434 lb. in 1915. Although falling off again for the next three years trade was resumed in large volume in 1919, and by 1922 had reached 1,624,892 lb., the largest import on record. Since the Act of 1922, however, imports have been negligible. Italy is the principal competing country. Quantity and value of imports of citric acid since 1908 are shown here.

Imports of Citric Acid into the United States, 1908-1925

Year	Rate of Duty per pound	Quantity	Value	Duty Collected	Value per unit of quantity	Average ad valorem rate per cent
1908	.07	171,795	$62,804	$12,025	$0.366	19.15
1909	.07	243,010	74,209	70,010	.305	22.92
1910	.07	142,001	40,967	9,940	.288	24.26
1911	.07	97,847	28,717	6,849	.293	23.85
1912	.07	67,332	20,275	4,713	.301	23.25
1913	.07	8,677	2,916	607	.336	20.83
1914	.05	471	192	32	.404	17.17
	.05	651,739	304,155	32,586	.467	10.71
1915	.05	722,434	447,131	36,121	.619	8.08
1916	.05	171,877	107,603	8,593	.626	7.99
1917	.05	157,528	91,463	7,876	.581	8.61
1918	.05	196,590	126,066	9,829	.641	7.80
1919	.05	1,224,591	1,187,267	61,229	.97	5.16
1920	.05	1,621,577	1,426,195	81,078	.88	5.67
1921	.05	770,331	632,780	38,516	.82	6.09
1922	.17	1,624,892	609,198	276,232	.37	45.95
1923	.17	575,541	199,522	97 842	.35	48.50
1924	.17	907 250	263 086	154 232	.29	58.60
1925	.17	288 574	79,634	49,058	.27	63.00

Citric acid presents a different tariff problem than most chemicals because of the division of the domestic industry between the California byproduct producers and the Eastern manufacturers from imported citrate of lime. The latter are primarily interested in maintaining a wide differential between the raw material and the finished product. The California industry is best protected by high duties on both products but its production is, at best, only a small fraction of the total consumption.

Under the Act of 1909 citrate of lime was entered free of duty but there was a tariff of 7c. per lb. on citric acid. The Act of 1913 imposed a duty of 1c. per lb. on citrate of lime and lowered the duty on acid to 5c. per lb. The Fordney-McCumber law in 1922 greatly increased both rates, raising citrate of lime to 7c. per lb. and citric acid to 17c. per lb.

Citric Acid and Citrus Oils in Italy in 1926

United States Consul L. G. Dawson at Messina reports that during the first quarter of 1926 the declared exports of the Italian citrus byproducts industry to the United States amounted to $725,381 as compared with $537,683 during the same period of 1925, an increase of $187,697. A very large part of this increased valuation of declared exports was made up of essential oils due to the higher prices of these oils in 1926. During the first quarter of 1925 the total exports of essential oils amounted to 258,840 pounds valued at $347,563, whereas in the same period of 1926 the exports amounted to only 228,510 pounds, but were valued at $478,259.

The exports of citric acid for the same quarter decreased from 104,160 pounds valued at $28,600 in 1925 to 11,200 pounds valued at $3,111 in 1926.

Recent Legal Decisions

Digest of typical cases decided in high courts, illustrating principles of law applied to business transactions

Water Sterilization Process Held Infringed by Mechanical Device

This suit was brought by Electro Bleaching Gas Co. upon certain claims of U. S. Patent No. 1,142,361 to Ornstein relating to a process for sterilizing flowing water. The defendant, Paradon Engineering Co., Inc., was accused of contributory infringement in manufacturing a machine which might be used and was used for the purpose of sterilization. U. S. Circuit Court of Appeals, Second Circuit, held that the plaintiff's patent was valid. The advance made by Ornstein was very great, and since the defendant offered for sale a device which could be used for the purification of water in accordance with the plaintiff's process, and by means which was the equivalent of the plaintiff's disclosed means, the decree for the plaintiff was affirmed.

Goldschmidt Thermit Patents Upheld

In the United States District Court, District of New Jersey, Judge Bodine handed down a decision on July 22 in which he found certain patents of the Goldschmidt Thermit Co. valid and infringed by Alumino-Thermic Corporation, Hugh G. Spilsbury and Henry J. Barnes. Suit was brought by the Goldschmidt Thermit Co. on three United States patents; No. 900,366 to Hans Goldschmidt and Felix Lange, No. 1,075,709 to Hans Goldschmidt and No. 1,153,435 to Felix Lange, assigned to the Goldschmidt Thermit Co. Defendants Spilsbury and Barnes were former employees of the plaintiff company, for 6 or 8 years, and organized the defendant company to carry on aluminothermic welding.

Patent No. 900,366 relates to the process of aluminothermic welding by means of superheated molten metal. The patent specifies the method of preheating the mold and the parts to be welded by forcing heated gases through the narrow channels of the mold spaces. The defendant claimed that preheating was old in the art of welding and sought to support this contention by reference to the prior art. The nearest anticipation was Goldschmidt's patent No. 729,573, but even this "disclosed no effective method for preheating the combined work pieces and the mold by a forced current of closely confined gas." In disposing of the defendants' claims the court paid high tribute to Dr. Hans Goldschmidt as "a great chemist and metallurgist" and continued: "The defendants claim him, since his death, as their consulting engineer. They also pay him the highest tributes in their catalogs, yet they seek to show that his patents were the mere descriptions of what was common knowledge."

Patent No. 1,075,709, is what is known as the Thermit patent which made a practical success of the thermit welding industry. It specifies the method of producing pure ferroso-ferric oxide from iron scale by means of a calcining process with subsequent magnetic separation. The product has substantially the composition Fe_3O_4 and is particularly active in bringing about the thermit reaction with aluminum. Prior to this invention Goldschmidt had experienced difficulty in obtaining uniform results in the thermit process. The defendant contested the claim that the product was ferroso-ferric oxide, but the Court held that "to arrive at such a conclusion one must reject the testimony of Professor Pond, obviously a disinterested and able chemist of the highest personal and professional skill; ignore the claims of Professor Goldschmidt, admittedly the pioneer in the art, and then reject the admission to the contrary contained in the defendants' own catalog, published before the dispute arose." Claims of anticipation in the prior art were dismissed as immaterial.

The last of the patents, No. 1,153,435 related to a railhead joint combining a butt weld and a fusion weld. The improved method consisted in inserting between the head portions of the rail ends a piece of the same material as that of which the rails are formed, then performing the fusion in the usual manner. The defendants again claimed that the whole scheme was disclosed in the prior art; further, that they inserted no metal between the railheads, but cut out the web and base of the rail. This the Court regarded as a subterfuge because substantially the same function is performed in substantially the same way.

All three patents were held valid and infringed and a decree was issued for injunction and accounting.

Duty to Make Full Disclosure

In the case of Reed vs. A. E. Little & Co., Supreme Judicial Court of Massachusetts it was brought out that Reed contracted with defendant's president to enter its employ and assign certain patents for which he would receive $75 per week and ten per cent of the selling price of the patents. Defendant obtained an offer of $3,000,000 for the patents and, without disclosing to Reed the details of the offer, induced him to make a new contract accepting $50,000 for the patents. Subsequently the patents were sold for $2,000,000 whereupon Reed sued to set aside the second contract. Defendant contended that it owed no duty to Reed to disclose the true facts, but the Court held that inasmuch as Reed reposed confidence in the defendant's president, who accepted that confidence and pretended to act as his friend and advisor, full disclosure and honest advice were incumbent upon the defendant.

Oil Cracking Process Suit Dismissed

In the U. S. District Court, Southern District of Texas, Judge Hutcheson dismissed on July 21, the suit of the Texas Company against the Gulf Refining Co. in which the plaintiff claimed equitable title in the petroleum cracking patents of A. M. McAfee. McAfee was originally employed by the Texas Company as a skilled chemist under the direction of G. W. Gray. During his employment McAfee invented a process relating to the conversion of high boiling petroleum hydrocarbons by the use of aluminum chloride. Gray patented the process and assigned it to the Texas Company. Later McAfee entered the employ of the Gulf Refining Company and obtained new letters patent on his process. A long litigation followed during which the Texas Company denied the validity of McAfee's patent and contended that Gray was the inventor. In the present suit it contended that it was the equitable owner of McAfee's patent. The court dismissed the bill, however, maintaining that the Texas Company's prior course of action was such that it would not now be permitted to claim title to the invention.

On the Engineer's Book Shelf

Evaporation

EVAPORATION. By *Alfred L. Webre*, assisted by *Clark S. Robinson*. The Chemical Catalog Company, New York. 500 pp. Price $8.50.

Reviewed by Paul D. V. Manning

The purpose of the authors, we read, is "to set down clearly, . . . their version of the information on the subject of evaporation as known today." After studying the book, the reviewer feels that not only has this purpose been well accomplished, but the information has been so presented that the reader is able to grasp and use it easily. Almost all points are illustrated with examples of the application of the data and facts to practical problems. Enough theory in simple language has been put in the treatise to make it easily understood by the average technician.

Considering the statement found in the introductory chapter of the book, "It has been estimated that there are at least 50 such variables, all affecting the final design" of evaporators, there is at least room for differences of opinion when the variables and conditions are not always known. The judgment and knowledge of a man who has been 20 years in this work, designing, installing and operating the various types of such equipment, are to be respected. This is especially true for evaporating equipment, since it is for the most part so slightly understood, the average user being inclined to accept the problems as already solved and not consider them seriously.

The book is divided into 4 sections. The first section covers in about 150 pp. the theoretical considerations of design and operation. The fundamental physical laws are discussed, many practical examples being given. At the same time, the limitations of theory in the light of present knowledge are recognized. The weak points in various designs are pointed out.

The second section of 70 pp. gives instructions and data on the operation of evaporators and complimentary equipment. This section includes a chapter on the investigation of troubles of evaporator installations.

The first and third sections are, in the opinion of the reviewer, the most important. The author gives in the third section, 166 pp. on the general applications of evaporators to specific industries. Industries treated are those handling beet and cane sugar, extracts and dyes, crystallizing solutions, paper-mill waste liquors, organic and foamy liquids, delicate materials, heavier chemicals and glycerine liquors. The chapters on sugar solutions are complete and the various cycles of evaporator systems are shown, together with heat balances.

The fourth section takes up in 66 pp., the various commercial types of evaporators. This section was written by the various manufacturers of such equipment and although illuminating, is valuable chiefly because it will enable the prospective user of such equipment to differentiate between what is important to the engineer and what is important to the manufacturer. All types are not described, no information being found by the reviewer on the Peebles type, but the section is well worth while.

One is impressed with the extent of the authors' practical knowledge. There are few indefinite statements; the facts and figures are based on experience. The book is replete with useful charts, diagrams and photographic illustrations.

There are many short chapters, some of them occupying but a page or two. It might be more pleasing if a few of these were combined.

The volume will be useful to those who have or expect to have evaporator installations. The operating man will find it helpful and it is a valuable reference work on the subject.

Elements of Industrial Chemistry

ELEMENTS OF INDUSTRIAL CHEMISTRY. By *Allen Rogers*, supervisor of the industrial chemical engineering course and head of department of industrial chemistry, Pratt Institute. D. Van Nostrand Company, New York. 680 pp. Price $4.50.

The revision of "Elements of Industrial Chemistry," which first appeared in 1916, fills a definite need for a book comprising selected subject matter for students and others interested in chemical technology, but who do not possess advanced training in chemical theory. In general the treatment of industries is thorough, with the possible exception of pyroxylin plastics and lacquers, rayon, and reclaimed rubber, each of which receives but scant mention.

A Year's Achievements in Petroleum Technology

PETROLEUM DEVELOPMENT AND TECHNOLOGY IN 1925. Papers presented at symposiums of the Petroleum Division, at the New York meeting February 15-17, 1926; the Los Angeles, Calif., joint session January 21, 1926, and the Casper, Wyo., meeting August 28-30, 1925. Published by the American Institute of Mining & Metallurgical Engineers, Inc., New York. 784 pp. Price to non-members $5; to members $2.50.

As a record of a year of active service to the industry, the officers of the Petroleum Division of the A.I.M.E., have now had published in permanent form the papers presented before its 1925 symposiums and meetings. The volume thus created is one of the most impressive presentations ever given the technology of the petroleum industry. It numbers among its authors more than 100 contributors—most of them well and favorably known in the industry. The papers and discussions cover in appropriate sections production engineering (279 pp.); refining technology (140 pp.); world production (254 pp.); transportation engineering (52 pp.) and petroleum economics (66 pp.). The technologic developments discussed are not solely those of 1925 in spite of the title of the book. They cover all that is important, however, and obviously technology cannot always be confined strictly to calendar years.

A short foreword by H. Foster Bain, the Secretary of the Institute, and a somewhat longer review of "The Petroleum Division in 1925: Its Aims for 1926" by

F. Julius Fohs, its chairman, are especially enlightening. More than 10 per cent of the 8,600 members of the Institute have indicated a principal interest in petroleum technology by enrolling in the Petroleum Division. The resulting organization is thus the largest of the technical societies interested solely in petroleum technology. It has within its power an opportunity to do a great service for the industry, and the 1925 achievement, as reflected in this volume, is a considerable step in that direction.

Gas Association Proceedings

AMERICAN GAS ASSOCIATION—PROCEEDINGS, 1925. Issued by the Association, 342 Madison Avenue, New York City. 1328 pp. Price $7 to non-members.

The annual proceedings of the American Gas Association have now become the most important annual contribution to technical literature in this branch of industry. Many of the committee reports show the results of elaborate researches or summaries of technical operating practice that are never adequately reported in the periodical literature of the industry. It is important, therefore, that engineers interested in fuel processing, gas distribution, or gas utilization do not neglect these annual volumes. Their constantly increasing bulk is more than justified by the constantly increasing value of the technical articles.

Dictionary of Applied Chemistry

A DICTIONARY OF APPLIED CHEMISTRY. By *Sir Edward Thorpe*, emeritus professor of general chemistry and director of the chemical laboratories of the Imperial College of Science and Technology. Vol. VI, revised and enlarged edition. Longmans, Green and Co., Ltd., New York. 791 pp. Price $20.

The appearance of Vol. VI of Thorpe's dictionary of applied chemistry nearly completes the work of revision. Sodium compounds, spectroscopy, starch, sugar, sulphur compounds, sulphuric acid, synthetic drugs, tannins, terpenes and derivatives of tetralin are among the leading subjects of the present volume, which in every respect is on a parity with the high standard set in preceding members of the series.

Corrosion Causes and Prevention

CORROSION CAUSES AND PREVENTION. By *Frank N. Speller*, director of metallurgical department, National Tube Company. McGraw-Hill Book Company, Inc., New York. 621 pp. Price $6.

Those who have waited patiently for the appearance of Dr. Speller's book on corrosion will not be disappointed.

With the generous financial assistance of the National Tube Co. as an assurance, much original investigation on the corrosion of ferrous metals has been completed; and many other agencies and individual specialists have assisted in making the work what is unquestionably the most advanced, inclusive and authoritative of its kind.

Both theory and engineering practice have been coordinated in chapters, an outline of which will indicate the breadth of treatment: Introductory Outline of the Corrosion Problem—Nature and Mechanism of Corrosion; Theories of Corrosion—Influence of Methods of Manufacture and Treatment—Influence of Factors Internal to the Metal; Composition—Influence of Factors External to the Metal; Classification of Corrosion—Principles and Methods of Corrosion Testing—Relative Corrosion of Ferrous Metals—Prevention of Corrosion in the Atmosphere—Prevention of Corrosion Underwater—Prevention of Corrosion in Closed Water Systems by Removal of Dissolved Gases—Prevention of Corrosion in High Pressure Steam Plants; Boiler Water Treatment—Prevention of Corrosion in Steam and Hot Water Heating Systems—Chemical Corrosion—Prevention of Corrosion Underground—Stray Current Electrolysis.

Numerous charts, tables and citations from the literature make the book of great value as a reference. The time is ripe for a real book on ferrous-metal corrosion, and Dr. Speller's contribution satisfies this need.

Molybdenum, Cerium and Related Alloy Steels

MOLYBDENUM, CERIUM AND RELATED ALLOY STEELS. By *H. W. Gillett* and *E. L. Mack*. American Chemical Society Monograph Series. The Chemical Catalog Company, Inc., New York. 299 pp. Price $4.

Reviewed by Robert S. Williams

Considering first the limitations of plain carbon steel, the authors then discuss the effects of alloying elements as a class. The individual alloying elements are next considered with special reference to the characteristic properties which they give to steel either alone or in combination.

The next section and in fact almost all the rest of the book deals with the effects of molybdenum on the mechanical properties of various steels. Little reference is made to cerium throughout the book. Published data on molybdenum steels is critically reviewed and correlated.

Probably the most important section of the book deals with the tensile and impact studies made by the authors at the U. S. Bureau of Standards. This information is given in detail and summarized in the form of graphs, many of which are given. Much attention is paid to endurance testing and endurance values and these results also are shown graphically.

In the concluding summary the authors say: "Cerium appears to have no true alloying effect in steel and to do no good. Since it gives rise to inclusions, it probably does harm." In view of this statement it is unfortunate that the word "cerium" should have so prominent a place in the title.

The book should be of interest to all users of alloy steel and should serve to stimulate the production of molybdenum steel. Several appendices follow the text showing in the form of tables the properties of molybdenum steels and a bibliography of more than 300 references is included.

The authors are to be congratulated on a most valuable contribution to the literature of the alloy steels.

Introductory College Chemistry

INTRODUCTORY COLLEGE CHEMISTRY. By *Neil E. Gordon*, professor of chemistry, University of Maryland. World Book Company, Yonkers. 688 pp. Price $3.80.

New books on college chemistry are appearing with notable frequency, and yet most of them have been justified because of wide variance in teaching methods, and because of rapid advances in the fundamentals of chemical science. Thus a redesign of books on inorganic chemistry is a desirable thing, and the present work has a fresh, up-to-date point of view, including the latest concepts of atomic structure. There are appropriate illustrations featuring important developments and processes in applied chemistry.

Readers' Views and Comments

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Boiler Feed Water Studies Committee Denies Making Recommendations

To the Editor of Chem. & Met.:

Sir—It has come to my attention that certain companies manufacturing products for feed water treatment have so worded their advertisements as to indicate that the Boiler Feed Water Studies Committee is recommending their product for feed water treatment. If these statements are not contradicted the value of the work which the Boiler Feed Water Studies Committee is attempting to do may be retarded.

The Boiler Feed Water Studies Committee was formed for the purpose of studying the various processes in the purification of feed water employed in steam stations and on railroads. Research work is being carried on to determine the fundamental principles of certain phenomena which take place in steam boilers. The results of the findings of the various committees are to be published from time to time in the journals of the associated engineering organizations affiliated in this work.

The Committee has not given approval to any systems of feed water treatment and has not approved any product manufactured for internal treatment of boiler waters. Advertisements indicating this are untrue and misleading. The Boiler Feed Water Committee is sponsored by the following organizations: The American Society of Mechanical Engineers; The American Water Works Association; The American Railways Engineers Association; The National Electric Light Association; The American Society for Testing Materials.

S. T. POWELL, chairman,
Executive and Editing Committee.

Baltimore, Md.

Method of Preventing Bridging in Chutes or Hoppers

To the Editor of Chem. & Met.:

Sir—On p. 371 of the June number of *Chem. & Met.*, there appeared an article on "Method of Preventing Bridging in Chutes or Hoppers" by Maurice C. Cockshott. This method was invented and developed by me some years ago in plants of the Bunker Hill & Sullivan Mining & Concentrating Co., where it is still in use. The form described by Mr. Cockshott was our earliest type which since has been improved and patented (see U. S. Patent No. 1,570,795, filed Aug. 20, 1924, and issued Jan. 26, 1926).

During the last 4 years the device has been shown to all visitors to our electrolytic lead plant, where it is used to secure steady feeding of dried slimes, moist sands and concentrates, granular lead and all other materials that have a tendency to hold up in bins. We have in all, 28 of these diaphragm panels in service at the present time.

These panels are made in units which can be readily placed in any bin where trouble is experienced. Latterly we have developed automatic valves which make the use of any mechanically operated valves unnecessary. We believe there is a large field for such a device and we intend to place it on the market in the near future.

I hope you will see your way to correct any erroneous impressions which might arise as a result of the article in your paper. U. C. TAINTON.

Bunker Hill & Sullivan Mining & Concentrating Co.,
Kellogg, Idaho.

To the Editor of Chem. & Met.:

Sir—In reply to Mr. Tainton's communication on my article "Method of Preventing Bridging in Chutes or Hoppers," which appeared in the June number of *Chem. & Met.*, I wish to say that I gained the idea from a rubber hopper that I saw in use in England some years ago, and agitated by means of a pusher rod.

Had I known that such an article already had been developed, I would have gladly attempted to procure one from Mr. Tainton, rather than have gone to the trouble of inventing a device, the resemblance of which to the patent appears to be only in the general idea.

MAURICE C. COCKSHOTT.

Hollywood, Calif.

Whiskey in Every Loaf!

To the Editor of Chem. & Met.:

Sir—If you think any chemist reader of your "chemical" publication can see anything but prejudice in the editorial of July, 1926, entitled "Attention of Mr. Wayne B. Wheeler" you have another "think" coming. It may be possible that 1,000 kg. of bread dough contains enough sugars of one kind or another to make 5 liters of alcohol when fermentation is complete, it is not at all possible that fermentation is complete, and it is absolutely impossible for anything more than traces of alcohol to remain in the bread at baking temperature. Assuming that all of the sugars are fermented and all of the produced alcohol remains in the bread, one would need to eat an entire 1-lb. loaf of bread to obtain 1¼ teaspoonsful of 100-proof whiskey.

Your editorial, even written in a humorous vein, betrays the leanings of its writer. Like much of the argument in favor of a change in the prohibition law it does not convince the fair minded. The "wets" will always have the short end of an argument with the "drys," because of their personal or selfish desires. All "wets" I know wish to drink freely. All "drys" I know either do not drink or sincerely believe the country is better off under prohibition and are willing to forego their own appetite for drink for the larger good of the community. My opinion of your publication is not enhanced by such editorials. EDMUND CLARK,
Chemist.

New England Confectionery Co.,
Boston, Mass.

EDITOR'S NOTE: We hope we may be pardoned for an editorial prejudice against a fanatical enforcement of prohibition that fails to recognize the rights of legitimate chemical industry. As to our personal habits, the editorial betrayed no "leanings of its writer," except a penchant for humor that evidently missed its mark. Perhaps it was the heat. Anyhow we entirely overlooked the alluring possibilities of such an advertising slogan as "Whiskey in Every Loaf."

Selections From Recent Literature

Lithopone. Production and consumption of lithopone in various European countries and in America; status of the industry as compared with pre-war statistics. *Chem. Ind.*, July 7, p. 617-20.

Electrolytic Zinc. A considerable proportion (14 per cent in 1924) of the world's zinc is now produced electrolytically, principally in America, British Columbia and Australia. The process most used is the electrolysis of $ZnSO_4$. Eger, *Zeitschr. angewandte Chem.*, July 15, p. 866.

Lead. The new Harris salt-fusion method of refining lead has several advantages over the oxidation processes. It is relatively simple, and has low labor and fuel costs, and gives very pure lead, with separation and recovery of the other metals as such. The process is also applicable to the production of an excellent grade of hard lead. Schott, *Zeitschr. angewandte Chem.*, July 15, p. 867.

Insecticides. Commercial use of HCN is quite feasible, even in presence of most foodstuffs, if proper precautions are observed. Moths, ants, lice, crop pests and even mice and rats can be destroyed with little or no danger to human beings. Walther Herzog, *Chem.-Ztg.*, July 7, p. 493-4.

Nitroso Dyes. The nitrosodialkylanilines are useful as intermediates in making safranine and other dyes. Examples are cited for gray, violet and blue shades. A. Cobenzl, *Chem.-Ztg.*, July 7, p. 494-5.

Sulphates. The Bambach process of making Na_2SO_4 and $(NH_4)_2SO_4$ from $NaHSO_4$ and NH_3 has several advantages over the Chatfield method. The procedure and equipment for the Bambach process are described. Heinrich Molitor, *Chem.-Ztg.*, July 3, p. 485-6.

Mercury Poisoning. A symposium on the hazards of industrial and laboratory processes involving the use of Hg or its compounds or amalgams. It is held that even amalgam fillings in teeth are a potential source of danger and should be thoroughly investigated. *Zeitschr. angewandte Chem.*, July 1, p. 786-93.

Heat Resisting Alloys. The limit of heat resistance for alloys is about 1,300-1,400 deg. C. Such alloys are very useful for furnace parts, pyrometer tubes, heat exchangers, glass and enamelling furnaces, etc. Metal oxide coatings impart heat resistance, but are porous. Ni, Co and W are useful metals for making heat resisting alloys. Fry, *Zeitschr. angewandte Chem.*, July 1, p. 801-2.

Thermocouples. In the choice of metals for thermocouples, the low-melting and easily oxidizable metals must be excluded. Of the base metals, only Ni and its alloys meet the requirements. By very precise control of the Cr content, two alloys of Ni and Cr can be made which give a thermocouple closely approximating the accuracy of noble metal thermocouples. W. Rohn, *Zeitschr. angewandte Chem.*, July 1, p. 799-801.

Agava Alcohol. The pulp left behind in the commercial preparation of sisal fiber contains sufficient fermentable sugar to yield about 5 gal. of alcohol per ton of leaves. On this basis, recovery would be profitable only on plantations at least 5 years old and 400 hectares or more in area. Paul Baud, *Compt. rend.*, June 28, p. 1621-4.

Hydrogen. The cheapest process for large-scale production of hydrogen is the reduction of steam by iron. Technical problems in production and purification are discussed. For airships, the gas must be particularly free from CO_2 and other heavy gases. Albrecht von Skopnik, *Chem.-Ztg.*, June 30, p. 473-5.

Washing Powders. The usual long and tedious procedure for making washing powder can be greatly simplified, without any complicated or expensive machinery. The soap is run direct from the kettle into a mixer. By proper adjustment of the additions of soda and water in the mixer, the dry finished powder is obtained, ready for packing, in this one mixing operation. E. W. Albrecht, *Chem.-Ztg.*, June 23, p. 457.

Fuller's Earth. Difficulties in the use of crude natural fuller's earth can be met by proper use of artificial earth or of treated natural earth. In bleaching oils, when acidity causes trouble it may sometimes be necessary to neutralize the oil with alkali before bleaching. Light mineral oils are easily clarified by settling; only the vegetable oils and heavier mineral oils require filtration after bleaching. F. Vollrath, *Chem.-Ztg.*, June 23, p. 455-7.

Dye Chemistry in 1925. A review, with many references to patents and periodical literature. F. Mayer, *Chem.-Ztg.*, June 26, p. 465-7.

Graphite Lubricants. The relations of particle number, particle size and light absoption in graphite suspensions are discussed in detail. Illustrated with curves, tables, diagrams and equations. Felix Hebler, *Zeitschr. angewandte Chem.*, June 17, p. 741-4.

Treating Condensate. Efficient utilization of the heat content of condensate water; use of condensate as feed water for generating steam. L. Heuser, *Zeitschr. angewandte Chem.*, June 17, p. 752-3.

Roasting Pyrites. Pressure, temperature and gas concentration relations are worked out for the roasting of pyrite ores. The last portions of sulphur show increasing decomposition pressure. Curves and equations are given. G. F. Huttig and Paul Lurmann, *Zeitschr. angewandte Chem.*, June 24, p. 759-65.

Glass and Ceramics. Technical problems in glass making and in firing ceramic ware are chiefly problems of the physical nature of the materials and of the optimum temperature relations. For example, form stability of shaped articles depends on maintaining the internal friction. G. Keppeler, *Zeitschr. angewandte Chem.*, June 24, p. 774-5.

Nitric Acid. A description of the Toniolo process for absorbing nitrogen oxides in the production of synthetic nitric acid. Four plants have been built in Europe to work the process. Carlo Toniolo, *Giorn. chim. ind. ed appl.*, May, p. 275.

Aluminum Alloys. No alloy of Al will be improved by heat treatment (500 deg. C.) and aging unless it contains at least one substance which goes into solid solution in Al and shows decreasing solubility with falling temperature. The only elements now known to give solid solutions in Al are Zn, Cu, Mg, Si, Li and Be. Some of these alloys improve when aged at ordinary temperature; others must be kept hot (50 to 200 deg. C.) during the aging. A particularly useful compound for the latter type of alloys is $MgZn_2$. W. Sander, *Zeitschr. anorg. Chem.*, June, p. 144-51.

Electric Furnaces. The Tammann designs, for temperatures up to 3,300 deg. C., are described and illustrated. E. Lowenstein, *Zeitschr. anorg. Chem.*, June, p. 173-7.

Rubber Testing. Committee 83 of the D. V. M. T. (German Society for Testing Materials) has submitted in detail its proposed standard methods for physical testing and chemical analysis of rubber and rubber goods. Illustrated. *Gummi-Ztg.*, June 11, Supplement; 11 pp.

Oxygen for Aviators. Instead of steel cylinders of compressed oxygen, the liquid in vacuum bottles can now be successfully supplied for high altitude flights. The danger of sudden expansion or explosion due to splashing in the bottle is overcome by filling the bottles loosely with asbestos fiber or the like. Liquid oxygen can be kept as long as 6 days in enamelled metal vacuum bottles. Garsaux, *Compt. rend.*, June 21, p. 1525-6.

Anti-Knock Fuel. The only fundamentally sound means of avoiding knock is an engine design which permits mechanical cooling to control the ignition temperature and pressure. Pending the adoption of such a design, the next best solution is the use of a detonation retarder such as tetraethyl lead. Dumanois, *Compt. rend.*, June 21, p. 1526-8.

Caustic Recovery. The viscose process uses so much caustic that recovery is an important item. The dialysis method is being successfully applied to this problem. The process and equipment are described and illustrated. The apparatus is economical and safe, and gives a product which is free from organic matter and ready for use. Leonardo Cerini, *Giorn. chim. ind. ed appl.*, May, p. 227-35.

Caustic Recovery. Osmotic, electro-osmotic and cataphoretic processes are not commercially applicable for recovering the caustic used in making alkali-cellulose. A relatively simple and economical process of concentration by evaporation has been worked out. Illustrated. Ugo Orlandi, *Giorn. chim. ind. ed appl.*, May, p. 235-7.

Rayon. An illustrated description of the processes and equipment used in making rayon from viscose. Carlo Sandoz and Giulio Tocco, *Giorn. chim. ind. ed appl.*, May, p. 239-47.

Synthetic Ammonia. Illustrated description of the Merano plant of the Montecatini Co., using the Badische process. The plant makes its own electrolytic hydrogen. Angelo Coppadoro, *Giorn. chim. ind. ed appl.*, May, p. 248-56.

Rayon. Review of the rayon industry with special regard to conditions in Italy. Anon., *Die Chem. Industrie*, vol. 49, 1926, pp. 525-7.

Fertilizers. The value of nitrogen as a fertilizer. Lecture given by Prof. Dr. Warmbold at the international conference on nitrogen propaganda in Biarritz. *Die Chem. Industrie*, vol. 49, 1926, pp. 477-8; 501-3.

Gas Scrubbing. New methods for scrubbing of gases (Cont.). II. Recovery of gasoline from cracking gases. G. Weissenberger, *Chem. Apparatur*, vol. 13, 1926, 142-4.

Russia. The Russian industry and its need for chemical equipment. Carl Heinrich Peters, *Chem. Apparatur*, vol. 13, 1926, pp. 125-6.

Lampblack. Properties and uses of lampblacks prepared by different standard methods (Cont.). Hans Hardert, *Chem. Ztg.*, vol. 50, 1926, pp. 434-5.

Nitrocellulose Lacquers. New and old types of cellulose lacquers are discussed with special reference to solvents, methods of manufacturing, properties and uses. Fritz Zimmer, *Chem. Ztg.*, vol. 50, 1926, pp. 453-4.

Rayon. Rayon industry in Germany. Benno Schmidt, *Kunststoffe*, vol. 16, 1926, pp. 121-2.

Karbolit. "Karbolit," a new condensation product of phenols with aldehydes. Method of manufacturing and data on resistance to acids, alkalies, various organic solvents and to heat (Cont.). G. S. Petroff, *Kunststoffe*, vol. 16, 1926, pp. 124-5.

Bleaching. The use and action of natural and artificial earths in the bleaching of oils and fats. F. Vollrath, *Chem. Ztg.*, vol. 50, 1926, pp. 455-7.

Evaporation. The use of pre-evaporators in the sugar industry, describing the economy of different systems. From paper by P. H. Parr, *Int. Sugar Journal*, vol. 28, 1926, pp. 249-51.

Decolorizing Carbons. The comparative value of decolorizing carbons and their suitability for sugar refining. A. A. Blowski and J. H. Bonn, *Int. Sugar Journal*, vol. 28, 1926, pp. 203-7; 255-60. Also: Reply to Blowski and Bonn by the Suchar Process Corporation, *loc. cit.*, pp. 297-99.

Fuels. The cause of coking in coals. R. Quarendon, *Chem. & Ind.*, vol. 45, 1926, pp. 468-70.

Hard Rubber. Hard rubber as a material of construction in the chemical industry. Franz Druckenmüller, *Der Apparatebau*, vol. 38, 1926, pp. 149-51.

Lacquers. Recent progress in the field of lacquers, paints and driers (Cont.). Max Bottler, *Kunststoffe*, vol. 16, 1926, 127-8.

Steam Boilers. Heat balance and efficiency of a boiler plant. W. Graulich, *Chem. Ztg.*, vol. 50, 1926, pp. 433-4; 454-5.

Yeast. Review of the yeast industry. Charles Schweizer, *Chimie & Industrie*, vol. 15, 1926, 851-70.

Electrolytic Iron. From the Ti-Fe ores of Eastern Canada, Ti is produced for pigment purposes and Fe is recovered electrolytically. R. H. Monk and R. J. Traill, *Can. Chem. and Met.*, July, p. 154-5.

Silicon Steel. Cast Si steel has a higher elastic limit and greater elongation than ordinary cast steel of like tensile strength. The known properties show Si steel to be very valuable for structural steel, and further study would doubtless be beneficial. E. H. Schulz, *Zeitschr. angewandte Chem.*, July 1, p. 806-7.

Brass. Porosity and other defects in brass casting are considered. Problems of proportions and purity of component metals, and of the methods and conditions of casting, must be thoroughly studied if the defects are to be overcome. W. Reitmeister, *Zeitschr. angewandte Chem.*, July 1, p. 805-6.

Government Publications

Prices indicated are charged by Superintendent of Documents, Washington, D. C., for pamphlets. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free.

Commerce Year Book, 1925. Bureau of Foreign and Domestic Commerce. A convenient summary of production, prices, and commercial statistics with reference to practically all trade subjects on which Bureau of Foreign and Domestic Commerce works. $1.

List of Publications of the Department of Commerce, May 1, 1926.

Short Tests for Sets of Laboratory Weights, by A. T. Pienkowsky. Bureau of Standards, Scientific Paper 527. 10 cents.

A Review of the Literature Relating to the Normal Densities of Gases, by M. S. Blanchard and S. F. Pickering. Bureau of Standards, Scientific Paper 529. 15 cents.

Shear Tests of Reinforced Concrete Beams, by W. A. Slater, A. R. Lord, and R. R. Zipprodt. Bureau of Standards, Technologic Paper 314. 50 cents.

Analysis of Synthetic Tanning Materials, by Edward Wolesensky. Bureau of Standards, Technologic Paper 316. 5 cents.

Action of Sodium Sulphate in Synthetic Tanning Materials, by Edward Wolesensky. Bureau of Standards, Technologic Paper 317. 10 cents.

Endurance Tests of Tires, by W. L. Holt and P. L. Wormeley. Bureau of Standards, Technologic Paper 318. 10 cents.

Subject Index of United States Government Master Specifications. Bureau of Standards, Miscellaneous Publication 73. 5 cents.

The Application of Chromium Plating to Printing Plates. Bureau of Standards Letter Circular LC 177.

Procedure for Testing Explosives for Permissibility for Use in Coal Mines, with Test Requirements, Tolerance Limits, and the Schedule of Fees. Bureau of Mines, Schedule 17A. 5 cents.

Subject List of Reports of Investigations Issued During 1925. Bureau of Mines, Serial No. 2756.

Extinction of Methane Flames by Helium, by H. F. Coward, G. W. Jones. Bureau of Mines, Serial No. 2757.

Explosibility of Oil-Shale Dust, by V. C. Allison and A. D. Bauer. Bureau of Mines, Serial No. 2758.

Gases Commonly Used in the Industries and the Home and Their Hazards, by A. C. Fieldner. Bureau of Mines, Information Circular 6009.

Leakage Losses from Pipe Lines Carrying Natural Gas Under High Pressures, by E. L. Rawlins. Bureau of Mines, Information Circular 6010.

Mineral Production Statistics for 1924 on Gold, Silver, Copper, Lead, and Zinc in Utah, by V. C. Heikes. Bureau of Mines, Mine Report. 5 cents.

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The Plant Notebook

An Exchange for Operating Men

Painting for Sulphide Protection

One of the large university laboratories has been having a great deal of difficulty with sulphide scale on copper lashing and cornices of the laboratory building. This situation was aggravated seriously because the hydrogen sulphide generator house was on the roof of the building. Bituminous paint is apparently wholly ineffective but an aluminum paint has proven entirely satisfactory for elimination of the corrosion of the copper roofing parts.

This development indicates that many plant corrosion problems where sulphides are a serious factor may be helped materially by aluminum paint. It should be recalled in this connection that the only satisfactory vehicle for this paint is a very high-grade spar varnish.

Some Suggested Applications of Water Deaeration

By D. H. Jackson
Jeannette, Pa.

The removal of dissolved oxygen and carbon dioxide from water to prevent corrosion is not a new art, but the relatively recent origination of the process and the prospect of adapting it to other problems in the field of industrial chemistry make it a subject of vital importance at the present time.

This process has been developed to meet the particular requirements of applications to steam and hot water plants. The flexibility and simplicity of the equipment required, together with its thoroughness of operation in removing all dissolved gases suggest that it could be profitably applied to numerous problems in various chemical industries where it is desirable to remove dissolved gases from liquids.

All natural waters contain appreciable amounts of dissolved oxygen, the quantity usually approaching saturation. The saturation point depends, of course, on the temperature and pressure. The curve shown in Fig. 1 gives the amount of oxygen contained at various temperatures and atmospheric pressure. A curve is also shown on a different scale giving the solubility of air in water. It will be noted that at 212 deg. F. the oxygen content is zero. This does not mean, however, that merely bringing water to the boiling point will remove all dissolved oxygen. It has to be maintained at the boiling point for approximately 15 minutes before equilibrium is established and all the oxygen is driven off.

The conventional type of open heater removes the majority of dissolved oxygen when operated at a temperature of 212 deg. F. or higher, and properly

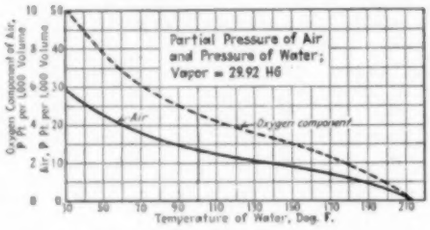


Fig. 1—Solubility Curves for Oxygen and Air in Water

vented. Under these favorable conditions, it is possible to reduce the oxygen content to a residual amount of 0.2 cc. per liter. This residual quantity is hard to remove and, while small compared to the original amount contained in raw water, is sufficient to cause some corrosion.

The process is as simple and efficient as it is thorough. The apparatus made by the Elliott Co. has no moving parts, other than a float controlled valve. It fits in a boiler feed line or other hot water line with very little extra piping and is entirely automatic in its operation. The diagram shown in Fig. 2 illustrates the principle of operation. The water is first heated in either an open or closed type of heater or a combination of the two and then passed through one or more spring supported spray head valves into the separator chamber. The spring supported valve sprays the water in a cone shaped column into the separator chamber. The temperature in the heater is regulated so that it is 20 to 25 degrees higher than the temperature at which it is desired to deliver the water. If the required temperature of the deaerated water is 140 deg. F. the heater temperature would be maintained at approximately 165 deg. For these operating temperatures a vacuum of 24 in. of mercury would be maintained in the separator chamber. This is the vacuum which corresponds to the operating temperature of 140 deg. F. The water at 165 deg. F. entering this region of vacuum boils violently at the expense of the heat it contains. The action has been very accurately described as explosive boiling. The temperature is almost instantly reduced 25 degrees with the generation of a large volume of steam. This reduction of temperature is equivalent to boiling about 2 per cent of the total amount of water as it passes through the separator. The explosive boiling process as the water sprays into the separator and flows over the cascade pans under vacuum is very effective in removing all dissolved gases. The mixture of gases and the large volume of steam generated is drawn through a surface condenser where the steam is condensed and flows back into the separator. The non-condensable gases are drawn off by the vacuum equipment which may be either a steam jet or a mechanical air pump. The gases are drawn through the vacuum equipment and discharged to the atmosphere, through an auxiliary condenser if a steam jet is used, or direct if a mechanical air pump is used. The auxiliary condenser for the steam jet recovers all the heat in the operating steam through the jet. The cooling water for the separator and auxiliary condensers is the main source of cold water supply to the heater. In other words, the water goes through the circulation passes of the two condensers before going through the heater. In this way all the steam formed in the vacuum chamber and all the pressure steam used by the jet is condensed, making the process 100 per cent thermally efficient, with the exception of radiation losses. The vacuum is controlled automatically by a diaphragm-operated valve. In this way the temperature of the outgoing water from the deaerator is maintained more nearly constant than would be possible with any of the usual types of thermostatic valves. Storage space is available in the bottom of the separator chamber. The quantity of water in this storage space is maintained constant by a float controlled valve. Water can be drawn from the storage space by the boiler feed pump or other pump depending upon the application of the equipment.

The equipment can be operated at different temperatures by merely adjusting the vacuum control and the heater temperature. The temperature range of successful operation for complete deaeration runs from 130 deg. F. up to 212. Operating temperatures lower than 130 degrees can be maintained but deaeration is not quite complete. At temperatures as low as 60 degrees the oxygen can be reduced from an initial content of 6.8 c.c. per liter to a residual content of 0.6 c.c. per liter by recirculating the water. At the lower operating temperatures it is of course impossible to carry on the

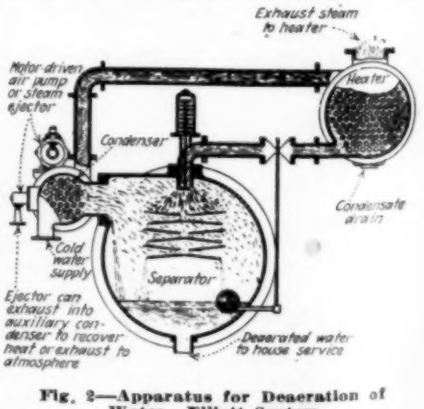

Exhaust steam to heater
Motor-driven air pump or steam ejector
Heater
Condenser
Condensate drain
Cold water supply
Separator
Ejector can exhaust into auxiliary condenser to recover heat or exhaust to atmosphere
Deaerated water to house service

Fig. 2—Apparatus for Deaeration of Water—Elliott System

explosive boiling process which accounts for the fact that all the oxygen cannot be removed.

In addition to its value in power plants, steam heating systems and hot water service lines as mentioned above, the deaeration process is particularly applicable to certain industries where oxygen corrosion is troublesome. The pulp and paper industry is a good example of this application. The adoption of the process is well justified in a paper mill from the standpoint of advantages gained in the boiler room alone. The advantages effected in the mill itself, however, are equally as important. The prevention of corrosion in the steam lines and condensate return lines is an important factor. It is well known that distilled water has a greater corrosive action on iron and steel than natural water. The reason for this is not because distilled water contains more dissolved oxygen than natural water. It does have a slightly higher capacity for dissolving gases but never reaches the saturation point if the system is closed. The real reason is that the dissolved oxygen is more active due to the absence of dissolved mineral matter which usually tends to slightly retard the process of corrosion by forming a thin protective coating of scale deposit. The steam lines and condensate return lines are, therefore, very susceptable to corrosion and trouble is frequently experienced from this source.

Another big advantage of deaeration in paper mill work is that it affords air free steam for use in the drying rolls. The value of this is well known to those who use thermostatic control. In many cases thermostatic control of drying rolls has been tried and abandoned, necessitating hand control of the steam valves to regulate the temperature, with a considerable increase in operating expense. The temperature of the drying rolls must be kept within a very narrow range of variation and air collecting in any part of the steam space in a roll always makes this difficult. Air may come into the roll through the air relief valve or it may come in with the steam. If steam from deaerated water is used it will be entirely free from air and the air relief valve will not be necessary. This insures a uniform temperature throughout the steam space and makes thermostatic control practical and satisfactory.

Another application of deaeration is for softening water. The softening action is not complete since only the temporary hardness is removed, but aside from boiler operation, temporary hardness is usually most troublesome due to the fact that it is responsible for the precipitation of deposits of calcium and magnesium carbonate in hot water lines and other equipment. Calcium and magnesium carbonates, above a very small and harmless concentration, are dependent on dissolved carbon dioxide gas to hold them in solution. Deaeration removes all traces of free carbon dioxide, decomposes a large percentage of the bicarbonate and causes precipitation of carbonates in the separator chamber where they can be easily removed.

There are other applications for deaerating equipment which have not been tried but which are suggested. It could be applied for eliminating obnoxious gases from drinking water.

The equipment used for deaeration might suggest itself to the operator of by-product coke plants as valuable equipment for more economically removing ammonia from gas liquor. The recovery of ammonia in coke plants at the present time is usually accomplished by the Feldmann Process. In this process the ammonia is first driven off by live steam. It is probable that the Feldmann Process or other ammonia recovery process could be made more efficient by liberating the ammonia vapor from the liquor by explosive boiling. It is certain that the ammonia could be extracted at a much lower temperature. The completeness of the extraction would have to be determined by experiment.

Although the principal application of deaeration at the present time is for removing air and carbon dioxide from water, there is no apparent reason why the process could not be profitably applied to the removal of gases from liquids in general. The application might be extended to include the elimination or recovery of gases from organic liquids. The process might possibly be used to recover helium from crude petroleum. Possibly a gas rich in helium could be obtained by degasifying of petroleum at a low temperature.

A Suggestion for Pipe Fittings in Chemical Plants

Where screw fittings are required in the pipe lines of chemical plants, it has been found best to use tees in place of elbows and crosses in place of tees. The extra opening in each case is closed by screw plug. This permits easy cleaning or draining when necessary and also makes it possible to tap into the line without breaking the piping or connection.

Simple Planning Board for Batch Operations

A planning board for scheduling and indicating batch progress may be simply constructed by ruling on a board horizontal spaces of appropriate width for each day in the week, and vertical spaces crossing them, also of appropriate width, for each operation or department. The result is a square for each operation each day. Small disks of metal, colored differently to denote various materials, may be hung on hooks and placed in each square. These disks should be large enough to permit any notes concerning the material, such as delivery date, amount and so on to be written on them.

This planning board is particularly useful in plants in which the production is not continuous and uniform. When a given batch is started in a given department a disk is placed on the board in the proper place. As it progresses the position of the disk is changed. Thus a glance at the board will indicate exactly what condition prevails in each department at any time, and also the position of any order in its progress through the plant.

Lessening Corrosion Losses In Plant Metalwork

One of the ever-present problems in plants making or using corrosive chemicals is the incidental damage to metalwork exposed to fumes. Often this cannot easily be avoided because the extent of the metal involved precludes the possibility of using the expensive corrosion resistant metals. In such cases the metal surface must be protected as well as can be by a protective paint or other covering.

In many cases, however, a relatively expensive metal can replace a cheaper one, and yet show a saving. An instance of this occurred in a large chemical plant, where a copper chute, 10 in. in diameter and 30 ft. long was exposed to hydrochloric acid fumes. Under these conditions it lasted but 3 months. A Monel metal chute was tried and found to last 15 months. On this basis, the copper chute cost $1,300 yearly, while Monel metal cost but $440, showing that a real saving was obtained although the latter chute had a first cost about twice that of the copper chute.

Approximate Calorific Value of California Fuel Oil

By Marion E. Dice
Los Angeles, Calif.

The calorific value of a fuel oil may be determined accurately by means of a calorimeter, but the apparatus is expensive and the determination requires time and precision. For ordinary work a useful approximation may be made if either the gravity or the chemical analysis is known.

The formula of J. N. LeConte, as given in "Helios," Heine Boiler Co., p. 479, gives the value for oil of 17,680 + (60 × deg. Bé.) B.t.u. per pound.

The calorific value for California fuel oil varies about 40 B.t.u. per degree Bé. or degree A.P.I., which leads to the following formula, determined by experiment: 18,165 + (40 × deg. AP.I.) B.t.u. per lb. or 18,169 + (40 × deg. Bé) B.t.u. per lb.

The Dulong (Gebhardt, "Power Plant Engineering") formula, long used for estimating the heat value of coal, gives a value about 5 per cent high for California oil. The following expression should therefore be multiplied by 0.95:

$$14{,}544\,C + 62{,}028\left(H - \frac{O}{8}\right) + 4{,}050\,S$$

The letters C, H, O, and S denote the weight of carbon, hydrogen, oxygen, and sulphur per pound of fuel.

Consider an oil containing 85.29 per cent carbon, 11.44 per cent hydrogen, 1.59 per cent oxygen, 0.443 per cent nitrogen, and 1.188 per cent sulphur by weight, with a gravity of 19.6 deg. A.P.I. The calorific value by calorimeter is 18,949 B.t.u. per lb. The LeConte formula gives 18,850 B.t.u. The California formula above gives 18,949 B.t.u. The Dulong formula, multiplied by 0.95, gives 18,865 B.t.u.

For best results, the value should be determined from time to time by calorimeter and the formula changed in accordance with the results obtained.

Equipment News

From Maker and User

Electric Tools

The Chicago Pneumatic Tool Co., 6 East 44th Street, New York, N. Y., has recently added several tools to their "Little Giant" line of electric tools. These include a screw driver and nut runner in two styles—high and low speed, a universal tapper, a universal ¾ in. drill and a grinder.

Magnet Crane Truck

An industrial truck, driven by a gasoline motor through an electric generator and electric motors and equipped with a crane and lifting magnet, has recently been brought out by Baker-Raulang Co., Cleveland, Ohio. It has a lifting capacity of 1,000 lb. at 40 in. radius.

The use of this truck for handling iron parts is said to give a great saving over other methods. In unloading castings it is said to do work in 1½ man-hours that requires 12 man-hours when done by hand, which is not only a saving in labor cost, but also in time.

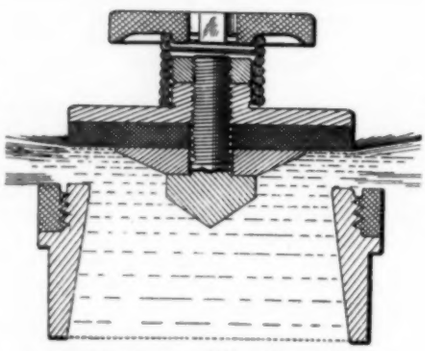
Tank Cars

The Standard Tank Car Co., Sharon, Pa., is now building tank cars of a larger size than any heretofore used. The first of these put out are used by Jones & Laughlin Steel Corporation for hauling tar. The extreme length of these cars is 48 ft., the extreme height 14 ft. 6 in., and the greatest width is 9 ft. 10 in. The cars are provided with 16 lines of 2 in. steam heating coils. There are 2 outlet valves operated from the inside of the tank and 2 operated from the outside. There are 3 domes in order to secure dome capacity. The total capacity of the car is 20,000 gal.

Direct Current Motor

The Louis Allis Co., Milwaukee, has introduced a new direct current motor, the type NA. This is a 40 deg. rating, general purpose motor with heavy overload capacity. The new series is interchangeable, rating for rating, in all essential dimensions with this company's polyphase motors.

The motor is designed for ventilation that will insure uniform cooling throughout the windings. Bearing chambers are designed to hold an extra quantity of oil, thus reducing attendance. The bearing inspection opening is closed by a removable cover. This metal cover, while permitting easy inspection, gives, it is claimed, a dust tight bearing chamber. The design is also said to prevent oil troubles due to oil soaked windings, from oil throwing, creepage and other causes.



Sectional View of New Pump Valve

Pump Valve

A new design of pump valve has been brought out by the Williams Gauge Co., Pittsburgh, Pa. It is called the William-Bullen valve and is shown in the accompanying drawing. The valve body is of Government bronze, the stud of Tobin bronze and the disk of a special composition called "Wigaco." Disks of other material can be supplied as required.

In designing this valve the webs have been eliminated from the inside of the valve. Additional care has been taken to reduce friction of flow through the valve to the utmost.

Gas Meter

A gas measuring device for use by small manufacturers of gas and large users of gas which is said to give an accurate measurement has just been placed on the market by the Cutler-Hammer Mfg. Co., Milwaukee, Wis.

This meter is called the "Cutler-Hammer Thomas Meter." It is made in sizes measuring from 2,500 cu.ft. up to 200,000 cu.ft. per hr. Readings are given in standard units, corrected for pressure and temperature. All corrections for pressure and temperature are automatically made. The instrument panel carries an integrating wattmeter and a recording wattmeter which gives a continuous record of the rate of flow.

These new meters are made in the following sizes: For 110 volt a.c. service, 25,000 and 50,000 cu. ft. per hr.; for 220 volt a.c. service, 100,000, 150,000 and 200,000 cu.ft. per hr. The instrument panel can be installed in any convenient place in the plant. The meter housing is installed in the existing gas line so that no special piping is necessary. The current regulator is incorporated in the instrument panel. This panel is provided with a glass door in order to make inspection easy and to give access to moving parts. Space is provided in the lower part of the panel for the storage of charts, chart ink and tools.

Melting Pot

Harold E. Trent, Philadelphia, Pa., has added a new unit to the line of electric melting pots. This pot has a capacity of 45 lb. It is controlled by a 3 heat switch and has separable plug connection. It is designed with a spout and handle so that it can be used for pouring as well as ladle or dipping work.

Hard Rubber Utensils

Belke Mfg. Co., 2925 W. Van Buren St., Chicago, Ill., has placed on the market a line of hard rubber utensils comprising buckets, dippers and pitchers for use in chemical and allied industries. The buckets are available in 2, 3 and 4 gal. capacity. The dipper is one 1 qt. capacity and the pitcher of 2 qt. capacity. These utensils are light in weight but are said to be strong and to withstand constant usage. The buckets and pitchers have lips so that acid can be poured without splashing or spilling. The handles are reinforced with steel cores.

Oil Burner

F. Beers & Co., Newark, N. J., are marketing a new design of oil burner called the P. & B. This burner, which is of simple construction, operates on the steam atomizing principle. It is said to require but 1.3 per cent of the steam generated for operation.

By the design of this burner, the parts that are liable to become heated are jacketed by the incoming steam, which results in preventing overheating by the steam absorbing excess heat. Within the burner the incoming oil enters in four jets, which are encountered by four jets of steam at right angles, the atomization taking place at this point. From this point the stream of atomized oil and steam passes through a nozzle and enters the burner for combustion.

This burner has been designed for compactness, and projects but a small distance into the furnace. It has no parts to adjust, and no moving parts.

On a recent test, the manufacturers say that with 75 lb. oil pressure and 120 lb. steam pressure, with oil at 120 deg. F., 14 Bé. gravity, with four ¼ in. by 3/64 in. steam ports and four ¼ by 1/16 in. oil ports, and a ¾ in. by 1 3/16 in. burner tip, one of these burners developed 1,000 boiler horsepower per hour maximum. The same burner is said to have developed a minimum of 25 boiler horsepower per hour while giving a steady fire.

The burners can be altered for both larger and smaller capacity by changing the oil and steam ports, and also the tip opening.

Pointer Gages

New gages for draft, pressure and differential have been introduced by the Hays Corporation, Michigan City, Ind. These instruments do not employ liquids, floats, tanks, gears, sector or magnets. Leveling is not necessary. The calibration is said to be permanent.

Large, illuminated scales are provided. The operating mechanism consists of a slack leather diaphragm and a cantilever spring attached to a pointer which is mounted on a pivot bearing. The diaphragm transmits the force of the draft or pressure to the spring, which in turn moves the counterweighted pointer and thus indicates a reading on the scale.

There are two types of these instruments. Type "F" is a round, flat case with an arc scale. Type "V" is arranged for close mounting and has a vertical scale reading from bottom to top.

Unit Pulverizer

A new type of unit coal pulverizer for supplying pulverized coal to boilers and other furnaces has been introduced by the Grindle Fuel Equipment Co., Harvey, Ill. This unit is of the multi-stage type and is designed for direct connection to the furnace that it is supplying with fuel. It is also said to be useful for pulverizing other materials such as pigments, chalk, charcoal, fullers earth, and similar substances.

The pulverizer consists of a series of swinging hammers mounted in five horizontal stages. The drive shaft is vertical and is direct-connected to an 1,800 r.p.m. motor. The housing which fits over the hammers has corrugated steel rings on the inside with a clearance between these rings and the hammers of about $\frac{1}{16}$ in. The material to be pulverized is first crushed to about 1½ in. or undersize, and is fed from a hopper onto a belt feeder. This belt passes over a magnetic pulley for the removal of tramp iron. The material then drops down a feed chute and falls on the top stage of the pulverizer. Any foreign material such as brass, wood, slate, or pyrites, which has passed by the magnetic pulley, is thrown out on the top of this stage by centrifugal force and deposited in a foreign material box located at one side of the pulverizer. The high speed at which the disks of the machine revolve throws the material which is to be pulverized out against the corrugated rings. The material tends to rebound from these rings and is then struck by the hammers, being pulverized in this manner sufficiently to pass down to the next stage.

An advantage claimed for this pulverizer is that it can be arranged to furnish a very low volume of air at a relatively high pressure for blowing coal from the discharge to the point of consumption, thus reducing the amount of excess air furnished the furnace. It also has a further advantage of necessitating the separation of but small quantities of air when the pulverized material is being passed to storage. The swing hammers are reversible and are reinforced at the points of wear. The rotor is equipped with self-aligning ball bearings. Other advantages of this device are said to be its safety due to the small amount of air used, which prevents combustion before the burners are reached. The high velocity of the mixture also is said to prevent flashbacks. The operation is said to be practically noiseless and dustless.

Gypsum Dust Collector

One of the most insistent problems of the plaster industry has been the collection of the dust liberated in gypsum calcining kettles, and usually carried into the atmosphere with the escaping steam. In most instances the plant has been erected at a point where complaints were rare, and the disadvantages of ordinary practice comprised only internal disorganization and local discomfort. With the erection of gypsum plants in the center of manufacturing districts, however, it has become essential to continued operation, to prevent litigation, trouble and expense. A plant of this kind was built recently by the Standard Gypsum Co. at Long Beach, Calif., and this article describes the design of William B. Senseman of Raymond Bros. Impact Pulverizer Co., which was there installed.

The original patent covered the discovery that a screen interposed across a chamber through which dust is drawn, with means for moistening the screen with water to cause a liquid film to cover the openings, are essential factors in the collection of the dust, which may then be discharged in sludge form from the bottom of the collector. A collector with this essential feature—a moistened screen—constituted the original installation at the Long Beach plant; but, although the unit operated effectively as a collector, troubles arose because of the difficulty of keeping the air duct to the cone free from deposited gypsum, which hardens rapidly.

The object of the original collector, shown in Fig. 1, was to effect an intimate contact between water and dust particles. This was achieved. In view of the peculiar properties of the gypsum before wetting, however, a change was made, and water was introduced into the fan. The screen, necessary for the handling of ordinary types of dust, then became unnecessary and was removed. Fig. 2 shows the design of the modified collector used at Long Beach. It will be noticed that the diameter of the screen section has been increased from 16 to 20 in., this change being made before it was realized that a screen was unnecessary. The main feature of the latest model, however, is the ease with which it can be dismantled for cleaning and inspection. The upper and permanent portion of the collector stack is suspended from the roof. A loose sleeve, held in place by a removable band, connects stack and collector. The top of the collector is removable, as is also the deflector baffle cylinder that, for ordinary dust collecting work, holds the screen in place.

Fig. 3 is a diagrammatic representation of the complete arrangement, illustrating the approximate relative dimensions of a 10-ton kettle, with auxiliary Senseman dust collecting equipment. An additional water supply to the collector is shown, but this is not necessary. The water used is drawn into the fan with the dust. The results are said to be entirely satisfactory, as evidenced by the absence of any solid material in the stack exhaust. Steam is given off in large quantity, but this is evanescent. The opening of the damper in the emergency discharge from the kettle quickly illustrates what happens when the collector is not in use: The cloud of white dust persists and is carried in the air for several blocks before settling.

The plant in operation at Long Beach consists of three 10-ft. kettles, each operating on a 2½-hr. cycle. Two kettles are equipped with collectors; and the collector for the third kettle, as illustrated in Fig. 2, is now being installed. The collectors used are each 3 ft. in diameter, with a 7-in. diameter

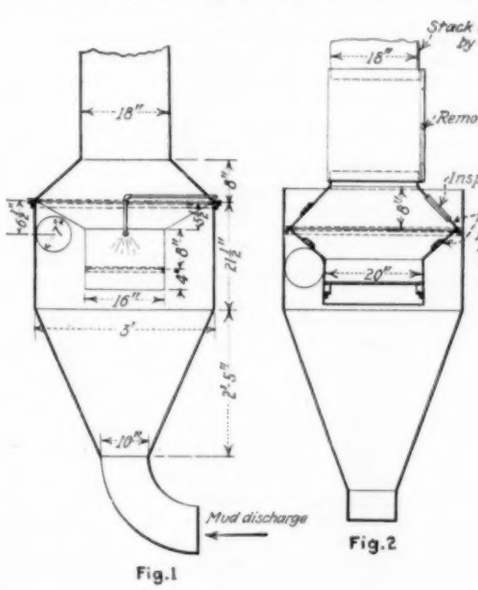


Fig. 1

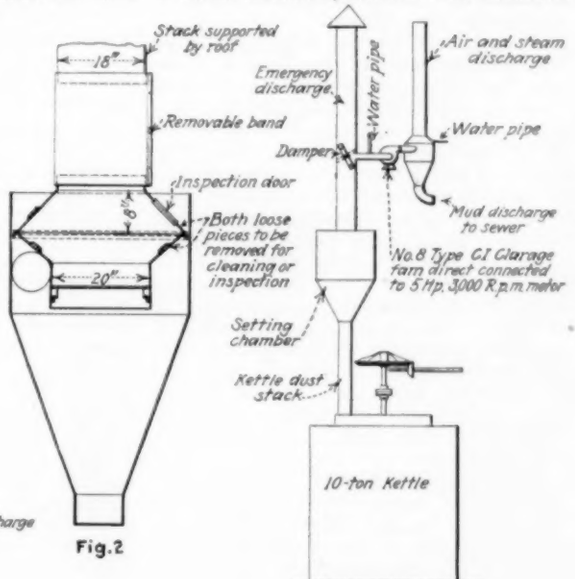


Fig. 2

Air and steam discharge
Water pipe
Water pipe
Mud discharge to sewer
No. 8 Type C.I. Clarage fan direct connected to 5 Hp. 3,000 R.p.m. motor
Setting chamber
Kettle dust stack
10-ton Kettle
Fig. 3

Fig. 1—Original Senseman Dust Collector
Fig. 2—Improved Collector, With Increased Screen Area and Inspection Facilities
Fig. 3—Diagram of Kettle and Complete Dust Collecting Unit

inlet and an 18-in. diameter stack outlet. The discharge pipe for sludge is 10 in. diameter. Between each kettle and its collector is a No. 8 Clarage fan, direct connected to a 5-hp., 3000-r.p.m. motor. The amount of water used is only 2.8 gal. per minute per kettle, the sludge discharge aggregating 3.3 gal. per minute, including condensed steam and entrained gypsum. This discharge carries about 20 per cent solids by weight, and amounts to about 3.9 tons per kettle per 24 hr. The utilizing of this material, now wasted, offers scope for inventive initiative.

Elevating Truck

Yale & Towne Mfg. Co., Stamford, Conn., has brought out a new elevating platform truck called the type K23E. It is of the low lift type, designed to carry heavy loads. It is designed to pick up a skid platform or drop same with great rapidity and has a small turning radius, making it adaptable for loading and unloading box cars, or operating in narrow aisles. It is provided with full electric safety devices and has relatively large wheels, which aid steering.

Electrical Equipment

A new line of direct current relays has been brought out by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. This line, called the "X" line, includes resistance measuring, over-current, voltage, polarized and relays of other types. It closely parallels this company's induction type alternating current line, and occupies about the same amount of switchboard space. These relays operate on the magnetic-vane principle and are said to be superior to previous direct current relays in that their operating values of current or voltage and their time of operation may be determined with a greater degree of accuracy. They are adjustable. The contacts are made of chemically pure silver.

A new back geared attachment has been brought out by the General Electric Co., Schenectady, N. Y., for use with its "500" series of induction motors. It has a cast iron base to which the motor and back shaft pedestals are fastened, consisting of a single casting. A special pedestal is used with this base, one casting forming the housing for the back shaft gearings. These and other features of the design are for the purpose of obtaining maximum rigidity and permanent alignment. A split gear case made from steel plate is provided to protect the gears from dirt and to retain the lubricating material in which the gears run. Two standard gear ratios are available. Steel or Fabroil pinions with cast iron gears may be used.

The General Electric Co. has redesigned its temperature over-load relay, known as the TC-121. The new relay is known as the Form C or TC-121-C. The improvements in design allow the use of renewable heating elements, prevent the bending of thermostatic strips by operators, and include improvements in the mechanical construction.

Another new development made by the General Electric Co. consists in an indicating device to show that the potential coils of a polyphase watthour meter are energized. An interruption of the potentional circuit on one element of the ordinary polyphase watthour meter is not always easy to detect, a blown fuse may go undetected for some time and in the meantime the meter registers only a portion of the power being delivered. With the new indicator, a few turns around the outside of the potential coil of each element serves as a transformer to energize a small low voltage lamp on the front of the base of the meter. One lamp is used for each element. A lamp out means an open potential circuit, and is quickly detected by the operator.

One of the recent developments of the General Electric Co. is a new line of adjustable supports for wiring installations. These are fixtures for permanent or temporary work which may be used on timber, masonry, structural steel or pipe framework.

Another new development of this company's is the polyphase watthour meter having three single phase elements. Two designs of this meter are available, the side connected, house pattern, type D-9 and the back connected switchboard pattern, type DS-9. This type of meter is intended for metering four-wire, three-phase circuits and is recommended where high accuracy is required, particularly where the circuit is unbalanced.

A new reversing primary resistor starter for squirrel cage induction motors is announced by the General Electric Co., bearing the type designation CR-7055-A-1. Two 3-pole line contactors are provided with this starter. These contactors are electrically and mechanically interlocked and are mounted back to back on the panel. The magnetic time interlock provides a predetermined definite time of from one to three seconds between the closing of the line contactor and of the accelerating contactor. Two-point starting is provided by a resistor designed to conform to the Electric Power Club classification No. 16. A temperature overload relay with an external resetting mechanism furnishes overload protection. The enclosing cage is of sheet metal, semi-ventilated, and is provided with feet for wall mounting. When mounted, the panel occupies a position at right angles to the wall. Doors may be locked and are provided at both the front and back of the panel.

A new General Electric Co. indicating lamp receptacle combines the functions of receptacle and resistor. This is suitable for use on switchboard panels, from 5/32 to 2½ in. thick and on circuits operated at from 24 to 280 volts. The principle advantage of this combined resistor-receptacle is that it allows the so-called supervisory connection of indicating lamps without incurring the possibility of inadvertently operating a breaker if the lamp or receptacle has become short circuited. An additional advantage is the elimination of fuses. The lamp used with these resistor-receptacles is rated 18 volts and 0.11 amperes. For 660 volt service a standard 140 volt resistor-receptacle may be used with an additional separate 5000 ohm cage type resistor.

Paint Spray

A paint spray or paint gun of a new design has recently been placed on the market by Alexander Milburn Co., Baltimore, Md. In this spray the paint enters a large annular chamber surrounding the air nozzle from which it is atomized and expanded in a venturi shaped passage by means of the air pressure. Atomization is regulated from a small to a large spray or entirely shut off by turning the nozzle. When the spray is shut off there is available a stream of clear compressed air for dusting and other purposes in connection with the work of painting. This spray is claimed to give a thorough atomization of the paint resulting in an even coverage with minimum consumption. This spray is of light weight and is compact with few moving parts.

Rotary Filter

After a number of years of experiment, W. D. Mount, consulting engineer Lynchburg, Va., has recently placed on the market a rotary vacuum filter specially designed for the purpose of washing paper pulp.

Experiments carried on with former types of these filters showed that the pulp had to be diluted to a consistency of 1 per cent before the filter could handle it. If this was not done the drum would not pick up a cake of uniform thickness. Such dilution required a greatly increased pump capacity and one of the advantages which is claimed for the new design of filter is that it will operate efficiently with a consistency of 2 per cent, and, therefore, a relatively small pump capacity.

The principle upon which this filter is based is that certain materials can be filtered most efficiently by providing for the displacement of large volumes of air. Therefore, the machine has an open drum which has given it a greater capacity. It has successfully handled vacuum pan salt, a material which is said to have always presented great difficulties for other classes of filters having small volumetric areas for air and filtrate. In pulp filtration the strong liquor must be kept separate from the water used for washing so that a filter of the compartment type must be employed. The new design incorporates with such a compartment filter certain features of the open-drum machine. Another difficulty in filtering pulp which is said to be avoided by the new design is the tendency of the pulp to "ball" in the filter trough.

It is claimed that this new machine in actual operation has given very good results. With a consistency of material going to the filter of 2 per cent, pulp is delivered from the wheel about 18 per cent dry at the rate of 1,000 lb. per sq.ft. of filter area in 24 hrs., bone-dry basis. The compartments are so arranged that only one is inactive at any given period, that is, 91.7 per cent of the filter area is continuously in productive action.

With this machine is used a specially designed trap, the two in combination forming a unit in which foaming liquors such as pulp magma can be handled without loss and with no reduction in capacity.

Gas Burners

Lee B. Mettler Co., Los Angeles, Calif., has added two burners to the line of natural and manufactured gas burners already made. These new burners are particularly designed for small industrial furnaces of all kinds in the smaller sizes. They are of the familiar Mettler design, operating at low pressure, No. 6 being equivalent to 40 boiler hp. at a maximum, while No. 12 is equivalent to 80 boiler hp.

Pipe Threading Machine

An electrically operated die stock for threading ⅜-, ½- and ¾-in. pipe has been developed by the Oster Mfg. Co., Cleveland, Ohio. In this device, the die head is driven by a fully enclosed, universal motor that will operate from any lighting circuit. Aluminum alloy housing is used and the weight is less than 35 lb.

The tool is placed on the end of a length of pipe as though a die stock were being used. It is centered by means of a universal chuck which gives proper alignment without loss of time. A separate die head is furnished for each size of pipe, so that the change from one size to another can be made by pulling out a pawl which holds the die head to the rotating sleeve, thus disengaging the head from the sleeve and allowing another head to be inserted. The dies are adjustable, so over- and under-sized threads can be cut.

The switch is located at the top of the tool. A quarter turn of this switch starts the die cutting, a second quarter turn stops the motor, while a third quarter turn reverses the motor and backs the die off the thread.

Pyrometer Controller

For controlling high temperatures, the Bristol Co., Waterbury, Conn., have developed a new pyrometer controller, model 479. This instrument has a 7-in. scale, the same as is used on indicating pyrometers. The governor used to regulate the speed of the driving motor is claimed to be reliable and positive in its operation. The mechanism which transmits power from the cam to the switch and which causes the switch to move up and down is adjusted and then pinned to insure against slipping. Other parts are adjusted and set with equal care.

The complete moving mechanism which supports the switch is assembled in one unit, supported rigidly in a bearing having a total area of about 4½ sq.in. and 6 in. long. A safety adjusting mechanism is provided for setting the position of the index at the point to which it is desired to bring the temperature. A hinged cover encloses the adjusting knob, which cannot be operated until the cover is opened. Opening this cover automatically forces the switch mechanism to its lowest position where it is entirely free from the pointer.

This controller is claimed to regulate temperature with great accuracy, a movement of the pointer too small for the eye to perceive being sufficient to make the regulator act.

Incinerator

To fill a need in special cases of dust and waste material collecting by air, where the material is not to be saved and prompt disposal by burning is convenient, the Northern Blower Co., Cleveland, Ohio, has developed an incinerator for use in connection with their dust-collecting system. This incinerator consists of a combustion chamber provided with suitable baffle plates and equipped with a gas burner at the front end. The material that is to be burned passes down the exhaust pipe outlet from the collector and enters the incinerator at a point above the burner. It is here consumed in the draft created by the exhaust air. The result is a small and inexpensive incinerator with a large capacity. The gas burner, which has a small demand, acts as a pilot light to ignite the material before any choking of the incinerator can occur. This burner is designed so that it cannot be blown out by the air blast.

This incinerator has been applied to industries producing waste shavings and saw dust and similar materials. In some cases the ash produced from the incinerator has a distinct market value.

Manufacturers' Latest Publications

Whiting Corporation, Harvey, Ill.—A new condensed general catalog of equipment made by this company, including cranes, foundry equipment, oven equipment, cars and trucks, overhead trolley systems, special machinery, pulverized coal-firing systems, evaporators, crystallizers, and other equipment.

Edwin L. Wiegand Co., Pittsburgh, Pa.—Two bulletins, one describing "Chromalox" electrical heating units of various types, and the other describing the use of these units for various industrial purposes.

Kirk & Blum Manufacturing Co., Cincinnati, Ohio.—A catalog of blower systems for dust collecting, pneumatic conveying and ventilating purposes in manufacturing plants, illustrating a number of applications.

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.—Special Publication No. 1734—A catalog of regulators for generator voltage control.

Poole Engineering & Machine Co., Baltimore, Md.—Bulletin No. 108—A new bulletin describing the Poole flexible coupling.

Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill.—Bulletin No. 83-C—A new bulletin describing gas compressors of several types.

The Hays Corporation, Michigan City, Ind.—A folder describing a new type of pointer gages for draft, pressure and differentials.

New Departure Manufacturing Co., Bristol, Conn.—No. 172-FE—A new leaflet on applications of ball bearings.

Carl Schleicher & Schull Co., 17 Madison Ave., New York, N. Y. — A pamphlet describing an ashless filter pulp for use with precipitates that are difficult to filter.

American Spiral Pipe Works, 50 Church St., New York, N. Y.—A folder announcing that the Taylor spiral riveted pipe, made by this company, is now made of copper bearing steel.

De Laval Steam Turbine Co., Trenton, N. J.—Three new pamphlets as follows: A pamphlet on the use of De Laval speed reducers and speed increasers of the helical gear type for use with standard speed motors; a pamphlet on the worm reduction gear with pressure oiling system; and a booklet describing the installation of pumps for the Fairmount pumping station of the City of Cleveland.

Aluminum Co. of America, Pittsburgh, Pa.—A pamphlet describing the use of aluminum in the manufacture of omnibus bodies.

Cleveland Crane & Engineering Co., Wickliffe, Ohio.—A pamphlet on the Tramrail system of material handling.

Midwest Air Filters, Inc., Bradford, Pa.—Two pamphlets, one on the installation of air filters at a steel plant and another describing the installation of air filters at the U. S. Gelatine Co., Carrolville, Wis.

Yale & Towne Mfg. Co., Stamford, Conn.—A folder describing pressed steel hand traveling crane ends.

New Jersey Foundry & Machine Co., 90 West St., New York, N. Y.—A folder illustrating various types of material-handling equipment made by this company.

Roller-Smith Co., 233 Broadway, New York, N. Y.—Bulletin No. 550—A bulletin describing type SR, direct current relays of the reverse current, overload, underload, closed circuit underload, overvoltage and undervoltage types.

Crouse-Hinds Co., Syracuse, N. Y.—Folder No. 38—A folder describing safety plugs and receptacles, interlocking switches and plugs, and safety hand lamps.

Udylite Process Co., Kokomo, Ind.—A booklet describing Udylite rustproofing by means of cadmium plating.

Lee D. Mettler Co., 406 So. Main St., Los Angeles, Calif.—A bulletin describing gas burners Nos. 6 and 12 for use with manufactured or natural gas in small sized furnaces and boilers.

Pittsburgh Electric Furnace Corp., Pittsburgh, Pa.—Bulletin I.—A bulletin describing "'Lectromelt" electric furnaces for laboratory use.

W. H. Nicholson & Co., Wilkes Barre, Pa.—Bulletins 526 and 626.—The first of these deals with tank type steam traps for central stations and industrial plants for all service and pressures from 2 to 600 pounds for use with saturated or superheated steam, compressed air or gas; and the second deals with piston operated traps for pressures from 2 to 400 pounds.

Bacharach Industrial Instrument Co., Pittsburgh, Pa.—Bulletin 293—A catalog describing the H-K optical pyrometer.

Combustion Engineering Corporation, 43 Broad St., New York, N. Y.—Catalog U-2—A catalog describing the unit system for burning pulverized fuel.

General Electric Co., Schenectady, N. Y.—Several new bulletins as follows: GEA-19E, describing AC enclosed magnetic switches; GEA-46A, describing synchronous motor and condenser panels; GEA-80, describing automatic reduced voltage starters for synchronous motors; GEA-135, describing 2300-volt, 90-inch, AC switchboards; GEA-185, describing manual contactors for AC or DC motors, 2, 3 and 4 pole, 600 volts or less; GEA-319, describing separable post type insulators for outdoor station eulpment; GEA-372, describing explosion chambers for high voltage oil circuit breakers; GEA-399, describing AC switchboards with oil circuit breakers for small generating stations and substations; GEA-467, describing automatic starters for slip ring induction motors; GEA-468, describing drum type controllers for use with direct current adjustable speed motors; GEA-415, describing constant speed induction motors for elevator service; GEA-416, describing automatic starting compensators for squirrel cage induction motors; GEA-435, describing multi-speed induction motors for elevator service

Hardinge Co., Inc., York, Pa.—Ruggles-Coles Division—Catalog No. 16A—A new general catalog of Ruggles-Coles driers.

Barrett, Haentjens & Co., Hazleton, Pa.—Bulletin No. 400A—A bulletin containing a reprint of a paper on automatic pumping.

Century Electric Co., St. Louis, Mo.—A folder describing stator and field windings.

Connersville Blower Co., Connersville, Ind.—Bulletin No. 20C—A bulletin describing cycloidal vacuum pumps with two-lobed impellers.

W. C. Lipe, Inc., Syracuse, N. Y.—A catalog giving a full description and specifications of the Lipe speed reducer.

Steere Engineering Co., Detroit, Mich.—Pamphlets Nos. 296, 299 and 305—The first of these treats of wash boxes for gas plants; the second of firebrick lining for water gas machines, and the third of sherardized cooling coils for gas plants.

American Blower Co., Detroit, Mich.—Bulletin Nos. 4413 and 7003—The first of these treats of reversible permanent wall fixture ventilators, and the second of class 15M American H S Fans, giving specifications and descriptions.

C. J. Tagliabue Mfg. Co., 18 Thirty-third St., Brooklyn, N. Y.—Catalog No. 417A—A new catalog of laboratory thermometers and hydrometers.

Celite Products Co., 11 Broadway, New York, N. Y.—New bulletins as follows: a booklet entitled "The Logic of Insulation" describing insulation and the advantages obtained from its use; a folder "Better Concrete" describing the use of Celite as a concrete admixture; and bulletin No. 115, describing Sil-O-Cel C-3, a semi-refractory insulating product and its use in concrete for construction work around furnaces.

Patents Issued July 6 to 27, 1926

Paper, Pulp and Sugar

Apparatus for the Manufacture of Oiled Paper. Louis L. Leadbetter, Huntington Park, Calif.—1,593,128.

Method of Making Waterproof Paper or Fiber Board. Albert L. Clapp, Danvers, Mass.—1,592,294.

Treatment of Paper or Other Fiber Material. August Schaefer, New York, N. Y. —1,591,238.

Process for the Conversion of Sulphite Waste Liquors Into Tanning Extracts. Webster E. Byron Baker, York Haven, Pa. —1,592,062.

Process of Preparing Concentrated Sulphite Cellulose Extract Containing Magnesium Compounds. Webster E. Byron Baker, York Haven, Pa.—1,592,063.

Method and Apparatus for Evaporation and Cooking of Sugar Juices. Aquilino R. Villa, Habana, Cuba.—1,591,583.

Rubber and Synthetic Plastics

Rubber Accelerator and Method of Making the Same. Guy H. Buchanan, Westfield, N. J., assignor to American Cyanamid Company, New York, N. Y.—1,593,385.

Treatment of Rubber with Aliphatic Diamines, and their Derivatives, and Products Obtained Thereby. Sidney M. Cadwell, Leonia, N. J., assignor to The Naugatuck Chemical Company, Naugatuck, Conn.—1,592,820.

Vulcanization of Caoutchouc and Product Obtained Thereby. Lorin B. Sebrell, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio.—1,591,441.

Vulcanization of Caoutchouc and Product Obtained Thereby. Lorin B. Sebrell, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio.—1,591,439.

Vulcanization of Rubber. Harry O. Chute, New York, N. Y.—1,593,017.

Vulcanized Material and Process for Making the Same. George A. Henderson, St. Albans, W. Va.—1,591,454.

Use of Lubricants in the Vulcanization of Rubber Articles. Charles Edgar Maynard, Northampton, Mass., assignor to The Fisk Rubber Company, Chicopee Falls, Mass.—1,591,767.

Process for the Treatment of Rubber. Fordyce Charles Jones, London, England.—1,591,132.

Method for Controlling Adhesion of Rubber. Harry A. Hoffman and John B. Dickson, Akron, Ohio, assignors to The B. F. Goodrich Company, New York, N. Y.—1,592,853.

Plastic Composition from a Resinous Body and a Liquid Ester of a Dicarboxylic Aromatic Acid. Courtney Conover, Crafton, Pa., assignor to The Selden Company, Pittsburgh, Pa.—1,592,082.

Resinous Bodies from a Phenol, Furfural, and Another Aldehyde and Process of Making the Same. Carleton Ellis, Montclair, N. J.—1,592,296.

Dehydrated Carbohydrate-Phenolic Resinous Products and Process of Making Same. Joseph V. Meigs, Jersey City, N. J. —1,593,342.

Complex Resin Composition and Process of Making Same. Carleton Ellis, Montclair, N. J.—1,592,773.

Liquid Coating Composition. Lawrence V. Redman, Caldwell, N. J., assignor to Bakelite Corporation, New York, N. Y.—1,591,999.

Petroleum Refining

Process of Cracking Petroleum Oil. Carbon P. Dubbs, Wilmette, Ill., assignor to The Universal Oil Products Company, Chicago, Ill.—1,592,560.

Apparatus for Cracking Oil. Ernest O. Linton, Hammond, Ind., assignor to Linton Gasoline Process Company, Chicago, Ill. —1,592,214.

Art of Cracking Hydrocarbons. Eugene C. Herthel, Chicago, Ill., and Edward W. Isom, Locust Valley, N. Y., assignors to Sinclair Refining Company, Chicago, Ill.—1,592,489.

Treatment and Refining of Mineral Oils. John Joseph Allinson, Bartlesville, Okla., assignor, by mesne assignments, to Doherty Research Company, New York, N. Y.—1,592,324.

Process of Purifying and Stabilizing Hydrocarbons. Frederick Klein, New York, N. Y.—1,592,603.

Process and Apparatus for Treating Hydrocarbon Oils. Chauncey Matlock, New York, N. Y., assignor to Gasoline Corporation, New York, N. Y.—1,591,428.

Portable Refinery. Thomas W. Sowell, Dallas, Tex., assignor to The Portable Refinery Company, Dallas, Tex.—1,593,107.

Process for Refining Mineral Lubricating Oils. James W. Weir, Fillmore, Calif.—1,592,058.

Oil-Recovery Apparatus. Fred P. Dodge, Port Arthur Tex., assignor to The Texas Company, New York, N. Y.—1,591,024.

Process of Refining Oil. Berry V. Stoll, Louisville, Ky.—1,593,275.

Decolorizing, Purifying, and Adsorbent Composition. James K. Stewart, Berkeley, Calif., assignor to Shell Company of California, San Francisco, Calif.—1,592,543.

Method of Treating Hydrocarbons. Roy Cross, Kansas City, Mo.—1,591,744.

Carbonization

Process for the Thermal Decomposition of Gaseous Hydrocarbons, Natural Gas, or the Like by Heat. Imre Szarvasy, Budapest, Hungary.—1,592,474.

Apparatus for Carbonizing Coal. Charles Hayes, Paris, France.—1,593,448.

Process for the Low and Medium Temperature Carbonization of Coal, Oil Shale, Wood, Peat, and the Like. James Rankin Garrow, Wimbledon, London, England.—1,593,333.

Process of Coking Coal. Harry H. Culmer, Chicago, Ill.—1,593,208.

Apparatus for Coking Coal. Marvin W. Ditto, New York, N. Y., and William M. Duncan, Alton, Ill.—1,591,023.

Process for Treating Carbon and Carbon Compounds Under Heat and Pressure. Friedrich Bergius, Berlin, Germany.—1,592,772.

Synthetic Bone Char and Method of Producing Same. Charles B. Davis, New York, N. Y.—1,592,599.

Process for the Distillation of Solid Bituminous Fuels. Hans Rosenthal, Berlin, Germany, assignor to Julius Pintsch Aktiengesellschaft, Berlin, Germany.—1,592,467.

Method of Distilling Bituminous Coal with Recovery of Gaseous Distillate. Robert M. Folsom, Reading, and Charles A. Raymond, Essex, Mass., assignors to New England Fuel and Transportation Company, Boston, Mass.—1,591,672.

Organic Processes

Manufacture of Diaminodiaryldialkylmethanes. Benno Homolka, Frankfort-on-the-Main, Germany, assignor, by mesne assignments, to Grasselli Dyestuff Corporation, New York, N. Y.—1,591,384.

Purification of Anthraquinone. Harry F. Lewis, Buffalo, N. Y., assignor to National Aniline & Chemical Company, Inc., New York, N. Y.—1,591,712.

Benzidine Flakes. William L. Spalding, Buffalo, N. Y., assignor to National Aniline & Chemical Company, Inc., New York, N. Y. —1,591,688.

Process of Making Phthalic Anhydride. Henry D. Gibbs, Penns Grove, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,591,619.

Process for the Chlorination of Hydrocarbons. Erich Krause and Koloman Roka, Constance, Germany, assignors to Holzverkohlungs - Industrie Aktien - Gesellschaft, Constance, Badenia, Germany.—1,591,984.

Method of Purifying Carbohydrate Solutions, etc. Charles B. Davis, New York, N. Y.—1,592,598.

Process for Preparing Halogenated Oxythionaphthenes. Erwin Hoffa, Hochst-on-the-Main, Germany, assignor, by mesne assignments, to Grasselli Dyestuff Corporation, New York, N. Y.—1,592,210.

Cellulose Acetate Composition. Bruce K. Brown and Charles Bogin, Terre Haute, Ind., assignors to Commercial Solvents Corporation, Terre Haute, Ind.—1,591,652.

Derivatives of Aminobenzoic Acids. Albert Rothmann, Heidelberg, Germany, assignor to C. F. Boehringer & Soehne G. m. b. H., Mannheim-Waldhof, Germany.—1,591,403.

Art of Deodorizing Isopropyl Alcohol. Carl O. Johns, Roselle, N. J., assignor to Standard Development Company.—1,593,304.

Denatured Alcohol. Emilio M. Flores, Buenos Aires, Argentine Republic.—1,591,084.

Method of Making Phenyl Ethyl Alcohol and Like Compounds. Ivan F. Harlow and Edgar C. Britton, Midland, Mich., assignors to The Dow Chemical Company, Midland, Mich.—1,591,125.

Dihydroxy Diphenyl Methane Compounds. Hans Jordan, Berlin-Steglitz, Germany, assignor to the Firm: Chemische Fabrik auf Actien (vorm. E. Schering), Berlin, Germany.—1,593,080.

Art of Manufacturing Thiazols. Lorin B. Sebrell and Clayton W. Bedford, Akron, Ohio, assignors to The Goodyear Tire & Rubber Company, Akron, Ohio.—1,591,440.

Black Disazo Cotton Dye. August Leopold Laska and Arthur Zitscher, Offenbach-on-the-Main, Germany, assignors to The Corporation of Chemische Fabrik Griesheim-Elektron, Frankfort-on-the-Main, Germany. —1,592,604.

Dihydroxy Diphenyl Methane Compounds. Hans Jordan, Berlin-Steglitz, Germany, assignor to the Firm: Chemische Fabrik auf Actien (vorm. E. Schering), Berlin, Germany.—1,593,081.

Poly-Iodinated Isatines and Process of Making the Same. Walter Schoeller, Berlin-Westend, and Kurt Schmidt, Berlin-Friedenau, Germany, assignors to Chemische Fabrik auf Actien (vorm. E. Schering), Berlin, Germany.—1,592,386.

Process of Making Alkali-Metal Xanthogenates. Edmund C. Missbach, Berkeley, Calif.—1,591,723.

Process of Making Cellulose Acetate. William R. Webb and Carl J. Malm, Rochester, N. Y., assignors to Eastman Kodak Company, Rochester, N. Y.—1,591,590.

Process of Manufacturing Benzoic Acid from Benzotrichloride. Frits E. Stockelbach, Douglaston, Queens Borough, N. Y., assignor to The Mathieson Alkali Works, New York, N. Y.—1,591,245.

Process of Treating Pine Oil. Robert C. Palmer, Pensacola, Fla., assignor to The Newport Company, Milwaukee, Wis.—1,593,030.

Process of Rendering Chlorides of Ketones Soluble by Treating with Sulphites Made From Waste Liquors. Antoine Regnouf de Vains, Miribel, France.—1,593,487.

Method of Making Activated Carbon. Hugh Rodman, Oakmont, Pa., assignor to Rodman Chemical Company.—1,591,235.

Inorganic Processes

Process of Treating Alunite. George S. Tilley, Berkeley, Calif.—1,591,798.

Process of Reducing Phosphate Rock. Henry Blumenberg, Jr., Los Angeles, Calif., assignor to Stockholders Syndicate, Los Angeles, Calif.—1,591,271.

Process of Treating Phosphate Rock. Henry Blumenberg, Jr., Los Angeles, Calif., assignor to Stockholders Syndicate, Los Angeles, Calif.—1,591,272.

Production of Phosphoric Acid. Robert Suchy, Bitterfield, Germany, assigner to Chemische Fabrik Griesheim - Elektron, Frankfort - on - the - Main, Germany.—1,593,514.

Process of Extracting Potassium and Phosphorus from Rocks. Joseph F. Cullen and Thomas E. Harper, Midvale, Utah, assignor to United States Smelting, Refining & Mining Company.—1,592,757.

Method of Reducing the Inflammability and Explosiveness of Hydrocyanic Acid. Friedrich Kerschbaum, Frankfort-on-the-Main, Germany, assignor to The Roessler & Hasslacher Chemical Company, New York, N. Y.—1,591,842.

Stabilization of Liquid Hydrocyanic Acid. Mark Walker, Los Angeles, Calif., assignor to The Pacific R. & H. Chemical Corporation, El Monte, Calif.—1,591,900.

Tricalcium Cyanide and Method of Producing Same. Robert W. Poindexter, Jr., Los Angeles, Calif., assignor to California Cyanide Company, Inc., New York, N. Y.—1,592,127.

Production of Alkali Metal Cyanides. Floyd J. Metzger, New York, N. Y., assignor to California Cyanide Company, Inc. New York, N. Y.—1,591,720.

Method of Removing Liquid From Cyanides. Charles B. Jacobs, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,591,630.

Stabilization of Liquid Hydrocyanic Acid. Mark Walker, Los Angeles, Calif., assignor to The Pacific R. & H. Chemical Corporation, Los Angeles, Calif.—1,591,899.

Cement and Process of Making Same. Edwin C. Eckel, Washington, D. C.—1,591,662.

Process of Producing Alumina, Alkali, and Dicalcium Silicate. Alfred H. Cowles, Sewaren, N. J., assignor to The Electric Smelting & Aluminum Company, Cleveland, Ohio.—1,591,365.

Manufacture of Alkyl Halides. Johan Pieter Wibaut, Amsterdam, Netherlands.—1,591,151.

Process for the Production of Alkali-Earth Metal Permanganates. Robert E. Wilson, Leon W. Parsons, and Stanley L. Chisholm, Cambridge, Mass., assignors to the Secretary of War of the United States of America, trustee.—1,592,480.

News of the Industry

Semi-Centennial Meeting of A.C.S. at Philadelphia

Pilgrimage Will Be Made To Grave of Joseph Priestley

Prominent chemists and scientists from various parts of the world have expressed their intention of attending the meeting of the American Chemical Society which will be held in Philadelphia, Sept. 6-11. This meeting will be in the nature of a semi-centennial celebration of the founding of the society. On Sunday, Sept. 5, the chemists will make a pilgrimage to the grave of Joseph Priestley at Northumberland, Pa., where the idea of founding the American Chemical Society was conceived fifty years ago. Prof. Gerald L. Wendt of Pennsylvania State College has been appointed chairman of a committee to carry out the program at Northumberland, which will be the opening event of the Society's Golden Jubilee Week.

Edgar Fahs Smith, for many years Provost of the University of Pennsylvania, will receive the Priestley Medal for 1926, Tuesday evening, September 7, at a public ceremony to be held in connection with the Golden Jubilee.

The Medal, awarded by the Society for outstanding achievement in chemical science, was established in honor of Joseph Priestley, the discoverer of oxygen.

The opening event at Philadelphia will be a meeting of the Society's Council at 9:30 a.m., September 6 at the Bellevue-Stratford Hotel, presided over by the president, Prof. James F. Norris of the Massachusetts Institute of Technology. At 2:00 p.m. on the same day a general meeting will be held. Mayor W. Freeland Kendrick will welcome the chemists, in behalf of whom President Norris will respond. Prince P. Ginori Conti will deliver an address on "The Development of Chemical Industry in Italy." Irenee du Pont will speak on "The Dyestuff Industry, Forerunner of What?"

Meetings of the Society's divisions will be held throughout the week. On Tuesday at 8:00 p.m. President Norris will deliver the annual President's Address, his topic being "A Look Ahead." At this gathering the Priestley Medal will be formally bestowed upon Dr. Smith, for many years Provost of the American Chemical Society. Dr. Smith will deliver the Priestley lecture on "Joseph Priestley."

The raw rubber symposium will be held Sept. 7 to 10. The symposium will offer a comprehensive survey of all botanical, chemical and engineering developments which are taking place or likely to take place, including the possibilities of artificial rubber.

Alcohol Denaturing Formulas Are Changed

Only four of the Internal Revenue Bureau's formulas for completely denatured alcohol remain. The follow:

Formula No. 1—100 parts by volume ethyl alcohol, not less than 160 deg. in proof; 10 parts by volume approved wood alcohol; 0.5 part by volume approved benzine (kerosene).

Formula No. 2—100 parts by volume ethyl alcohol, not less than 160 deg. in proof; 5 parts by volume sulphuric ether; 2 parts by volume benzine (kerosene); 1 part by volume pyridine, or 1 part by volume aniline oil.

Formula No. 3—100 parts by volume ethyl alcohol, not less than 160 deg. in proof; 2.5 parts by volume approved benzol; 0.5 part by volume nitrobenzol or ortho nitro toluol; 0.2 part by volume approved pine oil (steam distilled).

Formula No. 4—100 parts by volume ethyl alcohol, not less than 160 deg. in proof; 2 parts by volume approved wood alcohol; 0.25 part by volume approved pyridine bases; 0.50 part by volume approved benzine (kerosene); 0.50 part by volume approved gasoline.

All remaining supplies of alcohol treated under formulas Nos. 2, 6 and 7, as formerly numbered, are to be compounded further by the additional of one-half gal. gasoline to each 100 gal. of alcohol.

While alcohol prepared under any one of the four formulas is calculated to produce nausea and irritation of the elementary tract, officials at the Prohibition Unit deny that there is anything deadly in any quantity of these compounds that could be drunk.

The Unit's chemists are by no means satisfied with the formulas that they have, but the addition of gasoline makes them much harder to break than was the case before. They hope that better formulas will be devised, preferably those which would rely on a disagreeable odor or taste to prevent its use for beverage purposes. There is no thought of making any formula poison. Some consideration has been given to the possibility of increasing the amount of methanol from ten per cent to thirty per cent, but it has been decided definitely to make no change in the proportion of methanol. The British, both in the United Kingdom and in Canada, use thirty per cent methanol in their formula.

Early Decisions in Methanol and Bakelite Cases

With all the evidence before the Tariff Commission in the methanol and Bakelite cases, a decision as to what report will be made to the President is expected shortly after the end of the vacation season.

In the methanol case, the Commission is expected to recommend the full amount of the increase allowed under the flexible provision of the tariff law. Judging from the attitude of members of the Commission at the Bakelite hearing, it seems probable that it will favor having the exclusion order continued against articles infringing on Bakelite patents.

Hearings probably will be held in the early autumn to consider questions involved in the sodium silicofluoride, glue, and edible gelatin cases. The maximum increase is being asked. The foreign investigations in these cases have been completed.

Hearings on tartaric acid and barium carbonate probably will not be held until late in the winter. The foreign investigation has only begun. The gathering of this information probably will proceed rapidly as there seems to have been a change of attitude abroad toward the representatives of the Tariff Commission. The inevitable seems to have been accepted and there is a general tendency to give cost figures voluntarily.

Iodine Prices May Be Lowered To Increase Consumption

Indications that the Chilean producers may be willing to reduce the price of iodine to the point where it can be considered for industrial use has again aroused technical interest in the byproduct of the sodium nitrate industry.

The suggestion has been made that the producers well could afford to cooperate with possible users in research work, looking to the use of iodine in large quantities in industry.

A process for using iodine in the lixiviation of copper has been devised in Chile by Arturo Amenabar. That it has promise is indicated by the fact that an experimental plant was set up at the Army workshops and a commission approved by executive decree to report on the results. Representatives of the Nitrate Producers' Association, the Minerals Separation Co., Chile Exploration Co., Braden Copper Co., and the Andes Mining Co., are included in the membership of the commission.

News in Brief

Ohio State Offers Research Fellowship — The Engineering Experiment Station of Ohio State University announces that one of the fellowships which it offers for the coming year in co-operation with the Columbus Station of the Bureau of Standards, is unfilled. Graduates with the equivalent of a B. S. degree, proper training in ceramics, physical chemistry and an elementary course in crystallography and mineralogy are eligible. The income for the fellowship is $750 per annum.

First Linseed Oil Factory Established in Brazil—On May 15, 1926, the first linseed oil factory in Brazil was established at Rio de Janeiro by the Companhia Carioca Industrial. The plant had a daily capacity of 10 metric tons of seed, and it is expected that in the future sufficient oil will be produced to supply the greater part of the domestic demand. For the time being the raw materials will be imported from Argentina. Some time ago flax was raised in the States of Rio Grande de Sul and Santa Catharina but although a fair crop was produced by the latter State, no market was found for the seeds. However, it is probable that interest in this line will be renewed.

Mexico Will Regulate Oil Production—President Calles has issued a decree authorizing the government to regulate oil production in Mexico with the object of preventing exhaustion of the country's oil resources by immediate exploitation.

New Source of Salt Brine—As a result of oil prospecting activities in the Saginaw district of Michigan, a new source of salt brine seems destined to be developed for commercialized service. A stratum bearing salt water at 1,200 ft. has been encountered, and brine secured at this depth is reported to test at 100 per cent. The extraction has every indication of ready commercial possibilities. Heretofore, brine has been secured in the sand in the Marshall section at 600 to 700 ft. below the surface, testing on an average of 86 per cent.

University of Texas Adds Resources Division—The Board of Regents, University of Texas, Austin, has arranged for the establishment of a new division of activity at the institution covering the conservation and development of the natural resources of the state. It will include the industrial chemistry experiment station, the engineering experiment station, and the bureau of economic geology. The staff at the different branches will be considerably enlarged with chemists, testing engineers and geologists.

Thermite Used to Destroy Icebergs—Dr. Howard T. Barnes, of McGill University, Montreal, has been conducting successful experiments in breaking up huge icebergs with thermite, off the Newfoundland coast. With a couple of tons of thermite which he declares is "the answer to the iceberg problem," Dr. Barnes with a small staff went to Newfoundland to experiment. In an expedition which lasted three weeks, Dr. Barnes destroyed three bergs. The largest was 500 ft. long and was treated with 100 lb. charges. Another berg treated was 100 ft. long and 30 to 40 ft. out of the water. The first explosion took off a large mass of ice. Then the whole berg cracked and by next morning was broken up.

Large Platinum Output in South Africa — The growth of the platinum mining industry in South Africa is reflected in the official statistics of the Department of Mines and Industries for the four months ending April 30, 1926. Commencing with January, the output of crude platinum was officially estimated at 155,226 oz. In February platinum metals, including crude platinum totaled 780,664 oz., followed by 363,220 oz. in March, and 841,205 oz. in April. The platinum content of the crude platinum was 74.43 per cent in February, 74.17 per cent in March and 72.63 per cent in April. The total for the four months, therefore, was 2,150,315 oz.

Chromium-Plating Interests Consolidate—Plants, processes and patents for chromium plating owned by the Chemical Treatment Co. and the Chromium Products Corporation (subsidiary of the Metal & Thermit Corporation) have been taken over by the newly organized Chromium Corporation of America. John T. Pratt, who is to continue as president of the Chemical Treatment Co. and will also be chairman of the board of the new corporation, stated that by taking over the Fink and Grube patents, "the Chromium Corporation of America will own or control strong basic patents covering chromium plating under all conditions which are commercially feasible. It will also be allied with rapidly developing German interests."

Japanese Production of Indigo Paste Larger in 1925

According to reports to the Department of Commerce, the 1925 production of natural indigo paste on the island of Taiwan (Formosa) amounted to 3,067,379 lb., a small increase over the 1924 total of 3,043,500 lb. The production is for the most part consumed locally as indigo-dyed cloth is a staple requirement of the large Formosan-Chinese population. Of the 1925 production, the total exports amounted to only 35,992 lb., valued at $1,380 and were consigned to China. The area devoted to the growing of indigo, approximately 3,900 acres, has not varied materially in the past 20 years although since the Japanese occupation, tea cultivation has eliminated indigo in some sections.

It is stated that synthetic indigo is being produced by the Mitsui Mining Co. The quality and price of this domestic product is said to compare very favorably with the German dye. The receipts of synthetic indigo from Germany, the source of over 90 per cent of such imports, declined during 1925 to 2,100,000 lb. from a total of 3,238,294 lb. in 1924.

Demand for Bromine Stimulated By Increased Consumption

With large quantities of lead tetraethyl again going into gasoline, the question of bromine supply is arousing interest. It is believed many possible domestic sources of this material have not been investigated. This is particularly true of the saline lakes of the West.

While large quantities of bromine will be required if even as much as ten per cent of all gasoline is treated with this compound, there is no danger of a shortage, as Germany has ample resources of this material. The hope is expressed, however, that requirements can be furnished from domestic sources at a price below that necessary to bring out the German product.

Carbon Black Output Declined Last Year

The production of carbon black in the United States in 1925 amounted to 177,417,378 lb., according to reports made to the Bureau of Mines, from 63 plants operating in eight States. This production is a decrease of 9,454,656 lb., or 5 per cent, from the total output reported in 1924, and marks the first decline in yearly production of carbon black since 1920. On the other hand, deliveries to consumers in 1925 were higher than ever before, the total for the year, 175,631,326 lb., being an increase over 1924 of 36 per cent. This large increase in indicated consumption, despite the decline in production, resulted from a radical change in the situation as regards stocks, which were largely increased in 1924 but which remained steady in 1925.

Although the carbon black industry bettered its position as regards stock of carbon black in 1925, there was no favorable reaction as to price, which reached a new low level of 5.4c. as the average per lb. at the plant.

As has been the case for every year since 1921, Louisiana was the leading carbon black producing state, its output in 1925 of nearly 130,000,000 lb. comprising 73 per cent of the total for the country. Declines of 28 per cent in both West Virginia and Kentucky were recorded in 1925. These declines resulted in the main from a decreased supply of gas, which at the same time became more valuable for other purposes. Perhaps the outstanding event of the year as regards the production of carbon black was the rise to prominence of Texas, which displaced West Virginia as the second most important producing state.

Large Carryover of Arsenic in Canada

Sales of white arsenic by Canadian producers during 1925 amounted to 1,003 short tons, not including export shipments of concentrates and residues containing 713 short tons of white arsenic. Large stocks were built up in anticipation of a heavy demand, but the boll weevil was not so active, with the result that Canadian producers large stocks remained unsold at the close of the year.

News from Washington

By Paul Wooton
WASHINGTON CORRESPONDENT OF *Chem. & Met.*

FINAL plans are being completed by the Bureau of Mines to carry into effect the five-year program of prospecting for potash authorized by Congress at the last session. The U. S. Geological Survey has furnished a list of sites where the formation seems most favorable to the occurrence of the mineral. The date that drilling will begin will be determined largely by the length of time required to secure agreements with landholders under which the government will be reimbursed for its actual expenditures if minerals of value are found, and under which they are precluded from charging unreasonable prices.

It is not improbable that the University of Texas will co-operate in this work. That institution has sent E. H. Sellers, former state geologist of Florida, to Germany and France to study methods employed there in exploratory drilling operations. The Bureau of Mines will have the advantage of the recent solution of one of the region's drilling problems. The salt in many places is overlaid with Bentonite. This is a clay composed of volcanic ash. In fresh water it swells to sixty times its former volume. It has been found that the difficulty is avoided by keeping a strong brine solution in the drill hole. The drilling probably will be done by contract.

Now that a promising market has developed for bromine a close watch will be kept for that material as well as for rubidium and cesium, valuable alkalies which may be associated with potash.

Those planning the potash work are encouraged by the reports that potash has been encountered in sufficient thickness near Odessa, Texas, to cause the interests drilling there to feel justified in sinking a shaft.

Increasing demand for cellulose acetate has led to an effort to locate all sources of production in Europe.

Efforts are to be made by counsel for the Internal Revenue Bureau to expedite hearing before the Board of Tax Appeals of the case involving the Textile Alliance, Inc., which handled reparation dyes allocated to the United States in the years immediately following the end of the World War.

The Textile Alliance, originally organized as a membership corporation to handle wool and other commodities for American mills beginning in 1914 as an instrument through which the mandates of, first, the British government and, later, the United States government might be carried out during the war, took over distribution and sale of the German dyes at the request of the State Department under an agreement that no profits were to be distributed but that any surplus above operating expenses was to be paid, three-fourths into the Treasury with the understanding that the State Department would ask Congress for authority to expend this money for educational and scientific purposes, and one-fourth to be expended by the Alliance itself for similar purposes.

Originally, the Alliance was held to be exempt from Federal taxes as a business league not operated for profit. Subsequently, tax returns were demanded of it for the calendar years 1918 and subsequently on the ground that in these years, during which it handled dyestuffs, it was actually engaged in a regular business of a kind ordinarily carried on for profit. Returns were filed under protest. Early this year, the Commissioner of Internal Revenue certified a tax deficiency of $1,029,084.87 for the five years 1918 to 1922, inclusive, plus penalties of $257,271.22. The Alliance appealed. As it holds approximately $2,000,000 for distribution for educational and scientific purposes, payment of the tax and penalties claimed would leave only about $700,000. Unless expedited, the Board will not reach the case for a year.

One of the purposes of the hearing on tank car specifications, tentatively called by the Interstate Commerce Commission for September 14, is to learn the construction details of the various types of equipment now in use.

Such understanding as the personnel of the Commission has of the existing situation leads them to the belief that it is a confused one. With the active co-operation of all users of tank cars they believe certain standards can be worked out.

There is no thought of arbitrary action, it is pointed out. Ample time will be given before any changes will be put into effect. The proposed specifications which will be presented at the meeting will be open to the criticism of any owners or users of tank cars. The hope is expressed at the Commission's offices that they be altered at that time so as to cover every legitimate departure from the present standard.

Chemical manufacturers and carriers are concerned principally in seeing that no regulation is set up which will hamper the development of improved types of tank cars. For instance, at the present time a large amount of money is being expended in experiments with rubber lined metal tanks for transportation of certain chemicals such as muriatic acid.

Support from certain German chemists for the proposal to outlaw chemical warfare led to the suspicion in this country that their attitude may be prompted by the thought that the amount of tariff protection given the chemical industry would be reduced materially if the upbuilding of chemical manufacture were not linked with the national defense.

The ratification of the so-called poison-gas treaty, it is admitted, would remove one of the vote-getting arguments for adequate duties on dyes. Revision of the tariff cannot be postponed beyond the session of Congress which will convene next year. At that time it not only will be necessary for the chemical industry to defend its present schedule of rates, but it will have to urge increased duties on numerous articles, including the more expensive dyes. Practice has demonstrated clearly that this group will have to have higher rates.

For this reason, as well as for the more compelling one of national safety, it is believed that the chemical industry will take full advantage of the time before the convening of Congress to call public attention to the inadvisability of ratifying this treaty.

Investigations by the Department of Justice to determine whether there exists a combination of fertilizer producers and distributors to control prices have not reached the stage where a definite course of action by the Department has been determined, it is stated by officials.

Agents of the anti-trust section of the Department have been making inquiries in the field for several months, and these continue, it was said at the Department. If evidence of an illegal combination is secured, it will be presented to the Federal grand jury at Baltimore, it was said.

The fertilizer investigation was undertaken last winter after receipt at the Department of complaints through Senator Harris of Georgia and Senator Caraway of Arkansas that prices of commercial fertilizers were being maintained in such manner as to indicate agreements to that end.

Tear gas has become a great factor in preserving law and order. Police officials are more than pleased with their experience with it. The day is not distant, it is declared, when it will be a part of the equipment at every jail and will be available for the use of every law enforcement officer.

Labor endorses it for the expressed reason that it gives to the constituted authorities added power over mobs. The experience in Russia and Mexico has shown that it is labor that suffers most when orderly government breaks down. The wealthy can take up their residences away from the disorder, but the laboring man must remain and live through communistic or other convulsions.

Owing to complications regarding its foreign investigations, the Tariff Commission has sent Chairman T. O. Marvin and Commissioner E. P. Costigan to Europe to confer with various governmental officials and with representatives of producers.

Italy has protested against activities of agents of the Commission in connection with the investigation under the flexible tariff into costs of producing tartaric acid, Czechoslovakia has protested against the synthetic phenolic resin case, Spain objects to work concerning onions and there are other complications.

Members of the Commission believe that when the objects of the work of the Commission are explained fully, much of the force of these objections will be overcome.

Coal Strike Has Depressing Effect on British Manufactures

Chemical Industry Not Yet Greatly Affected—Interesting Addresses at Congress of Chemists

From our London Correspondent

THE COAL strike is unfortunately still with us and even the most sanguine cannot foresee an early ending. Coal from abroad is expensive and unsatisfactory, and the quantities available are insufficient to avert the creeping paralysis of the basic industries. Cement works are an exception and, of course, the gas industry had ample stocks ready for the emergency. The railways are running a full service partly with oil fuel, but the difference due to the use of Continental coal is often noticeable. The chemical industry is suffering to a smaller extent than might have been expected, but the final resultant depression may be greater and the cautious financial policy which is being adopted by the leading firms is a clear indication of the results anticipated.

The Congress of Chemsts

More detailed particulars of the Congress of Chemists are printed on another page, but a few impressions and notes are not out of place in this article. The trend towards big business and co-operative trading is gradually finding its counterpart in the closer relationships which are being formed among chemical and allied societies, with a central rallying point in the ideal of "Chemistry House." The Society of Chemical Industry is the obvious central organization or promoter of such a scheme but for the other societies and institutions the process is likely to be slow and wearisome. The annual meeting this year was a great success and C. S. Garland, as chairman of the executive committee, displayed real leadership and enterprise. The Earl of Balfour, recipient of the third Messel Medal, fully upheld in his Memorial Lecture the tradition of his predecessors, Viscount Leverhulme and Professor Armstrong.

A novel feature of the congress was the publication of "Congress Comments," a daily news bulletin, partly humorous in character and including some excellent caricatures. The British Chemical Plant Exhibition, though modest in its scope, was worthy of the occasion. Perhaps the most interesting exhibit was that of Prodorite, Ltd., a material which has been previously referred to in these notes, and which is now on the market. Prodorite is practically concrete, in which a special high boiling-point pitch, reasonably free from carbon, takes the place of cement and gives it substantially the same strength. Considerable research on grading of material, the use of special fillers, properties of the various pitches and practical experience have produced a new chemically-resistant material, which will find a useful place in chemical engineering practice. Floors, storage tanks and many items of plant for which chemical stoneware have been used, may be economically replaced by the new material, which has also been adopted for fume and chimney shafts and sewage work.

Visitors from America include Dr. Ellwood Hendrick, Professor Reston Stevenson, Professor James Kendall, Lt. Col. L. F. Goodwin, Professor of Chemical Engineering, Queen's University, Canada, Dr. Thomas H. Norton, Dr. F. G. Cottrell, Henry Wigglesworth, Dr. R. T. Elworthy and Prof. H. R. Moody.

Economics of Monopolies

One of the most interesting addresses delivered during the Congress was one on Economics of Monopolies by Sir Josiah Stamp, G.B.E., and it had particular reference to American conditions based on a recent trip to the United States. Sir Josiah thought that the efforts of countries to free themselves from the monopolistic control of raw materials by one country would lead to increased efforts in metallurgical and other research work to find substitutes. It was leading to appeals to the League of Nations by such countries as Italy for the distribution of the raw materials according to need. America for example, had coal and iron but was lacking in other materials such as manganese, chromium, nickel, tungsten and others. The whole world stood to gain by bringing together as cheaply as possible all the materials necessary to produce the products civilization needed. The result was that America was penetrating financially other countries to conserve her supplies and was trying to overcome the export control over foreign supplies. At present America and the British Empire control leading raw materials, the most important exceptions being Franco-German potash and Chilean nitrates. The United States on the one hand, wanted to maintain her own tariff walls while she deplored the inter-state tariffs in Europe that were based on racial divisions and not on sound economic lines.

One of the fallacies in thinking about raw materials both in the United States and in Europe was to consider that there was only one problem whereas three were involved. The first was presented by those countries which had a pure monopoly but which had no particular use for that monopoly. Such a country was a purely exporting one and imposed a tax on exports either for revenue or conservation purposes. The second type was a country having a monopoly of raw material, but while exporting that raw material was also anxious to develop home consumption. The third type was represented by an exporting country that also had developed home manufactures. A tax on exports could only be successful up to the level that would maintain consumption. If an excessive tax were imposed consumption would fall to such an extent that the total revenue would diminish. What the world was hungering for in industry in relation to all these problems was stability, knowing what its costs were going to be so that it could work to a program. If they could get stability in prices of raw materials it would be better even if the prices were 10 per cent higher than the average of fluctuating prices over a period of years.

Sir Max Muspratt was the next speaker and dealt with the British sulphuric acid industry, disclosing the interesting fact that of the sulphuric acid made in this country, 88 per cent was in the pre-war period made from pyrites, whereas last year, this figure had fallen to 48 per cent. The difference was not entirely due to manufacture from sulphur, as there had been a very considerable increase in the use of spent oxide from gas works.

The annual dinner of the Society was perhaps one of the most successful functions, the record number of 600 delegates being present. The principal speaker was Sir Alfred Mond, Bart, M.P., who gave an interesting and imaginative outline of the progress of science and its relationship to industry. Industry was not static but dynamic and could never stand still. There had been a time when people imagined that chemical science and commercial industry were a kind of prerogative of the German people. In developing his argument disproving this suggestion, Sir Alfred Mond showed himself to be an optimist as regards the future of Great Britain and based his view upon the fact that we were not at the end, but at the beginning of a scientific era. Science was the real wealth-giver of the world and without it there would be no interest, no stimulus and no future.

The new Institution of Fuel Technology has just issued its draft constitution and is inviting applications for membership. Although started under excellent auspices, it is felt that membership will not confer any tangible qualification, the Institution being rather closely linked up with business interests. On the other hand, it is likely to play a very useful part and satisfy a real need and there seems no reason why, just as in the case of the corresponding chemical engineering organizations, it should not work in complete harmony and without overlapping with the new Fuel Section of the Society of Chemical Industry, which is already in being.

Phi Lambda Upsilon Will Meet at Philadelphia

Phi Lambda Upsilon, Honorary Chemical Society, will hold its National Convention in Philadelphia, on Monday and Tuesday, Sept. 13 and 14. Accommodations for delegates have been arranged at the University of Pennsylvania, and the meetings will be held in the conference rooms of the John Harrison Laboratory of Chemistry. Dr. Ross Aiken Gortner, of the Department of Agricultural Biochemistry at the University of Minnesota, and national president of the fraternity, will preside.

France Seeks to Develop Domestic Supplies of Petroleum

Prospective Fields Reported in Southern France and in the Colonies—Competition for French Dye Trade

From our Paris Correspondent

PRIOR to the recovery of Alsace and the fields of Pechelbronn, France had no petroleum industry. Possession of the latter has stimulated search for new oil fields. At Gabian, in Southern France, borings have given interesting results. Shaft No. 1 is returning 20 tons of crude oil and shaft No. 4 gives 110 tons monthly. Prospects also are reported in some of the colonies natably in Madagascar and in Martinique.

High hopes are not held regarding the oil possibilities of these countries. In Algeria two concessions have been in force, one at Ain-Zeft which is not being operated and one at Messilah under which 1,800 tons of oil were produced last year. In addition, prospecting is being done in Morocco.

The only concern of real importance, therefore, is Pechelbronn with a production of 65,000 tons in 1925, less than that of 1924 which reached 78,800 tons. This company, which employs 3,600 workmen, recently put into operation at Merkwiller-Kutzenhausen, a modern refining plant which is equipped with distillation units of the latest design. The Pechelbronn naphtha, which is collected by pumping, is a heavy crude yielding about 10 per cent of light oil. What is left is used as lubricating oil and is able to take care of about one-third of French consuming needs.

The poverty of France in oil fields explains the scarcity of experienced oil men. An attempt to improve this condition has been made by establishing a chair of petroleum at the University of Strassburg. It is also planned to establish a school to impart a knowledge of the petroleum business to foremen and workmen.

About two years ago the government founded the Société Nationale de Recherches sur le Traitement des Combustibles. The laboratory of this society is at the Kuhlmann plant at Villers-Saint-Paul. Mr. Audibert who evolved the synthesis of methyl alcohol from water gas is the director of the laboratory. He had the task of finding out how to produce oil from coal. Experiments undertaken gave rather delusive results so this part of the original program has been given up. Mr. Audibert found that when coal is heated between 400 and 450 deg. C. in presence of hydrogen under a pressure of 150 kilog., it results in a hydrogenation and a pyrogenation. With one ton of coal he obtained, with such a treatment, 200 kilog. of gas and 400 to 500 kilog. of a liquor composed of one quarter phenol and three quarters of a mingling of hydrocarburets which are of the kind of crude oil. From this mixture we can gather 80 kilog. of motor gasoline; the residue is a heavy crude, more rich in aromatic than aliphatic carburets. As the process requires coal of the best quality and a high expense of power being necessary, it has been decided to give up these experiments for the present.

Mr. Audibert's studies in methyl alcohol having on the contrary given interesting results, the Société Nationale des Recherches has decided to pursue these experiments on an industrial scale. For this purpose a plant is under construction at Lens, North of France, which it seems can be put into operation in six to eight months.

The agreements of Feb. 12 and April 8, made between France and Germany and referred to in a previous correspondence, came to an end June 30 without definite result. Since July 1, the general tariff has been laid upon German goods entering France. In spite of this the I. G. has been doing a good business through its Paris office. The I. G. is forced to discontinue the sale of any dyestuff which is produced by French works prior to Aug. 15. This has stimulated the production of new dyes in France but has left much to be desired with respect to the quality of the new products.

In connection with the competition for the French markets it is noted that a new company with a capital of 500,000 francs has been established. This company was headed by Mr. Loewengard formerly of the I. G. but he has died since the formation of the new concern. Other principals include Mr. Norris, and American, formerly managing director of the dyestuffs department of the reparation commission instituted by the Versailles peace treaty, Messrs. Rais and Bohn, Alsatians, and Mr. Dewisme of Baignieres & Dewisme manufacturers of chemicals.

Meanwhile the French chemical industry in general is very unfavorable owing to the position of the franc. Prices for chemicals are climbing steadily but profits do not rise in proportion. All sales are made on a cash basis because of the money situation.

Output of Byproduct Coke Gains in Volume

During the first six months of 1926 approximately 31.6 million tons of bituminous coal were processed in byproduct ovens, according to figures of the Bureau of Mines. During the corresponding six months of the preceding year the coal processed was approximately 28.3 million tons. The output of byproduct coke was, therefore, about 12 per cent greater during the first half of this year than a year ago. This increase in tonnage of coal and coke was undoubtedly accompanied by almost the same percentage increase in the output of gas, tar, ammonium sulphate, and light oil. As a matter of fact the increased ammonium sulphate production was probably greater in proportion than the tonnage of coal processed, because relatively less ammonia liquor is now being made and more of the ammonia is being sold as sulphate.

Action of Synthetic Tanning Materials Investigated

An investigation of the action of sodium sulphate in synthetic tanning materials has been conducted recently by the Commerce Department's Bureau of Standards. In the manufacture of such materials, which are generally made from certain coal tar derivatives, formaldehyde and sulphuric acid, a certain amount of unchanged acid usually remains in the product at the end of the process. This acid would injure leather made with such tanning materials, and in order to get rid of it manufacturers generally add some caustic soda or soda ash which convert the acid to sodium sulphate or glaubers salt. This salt remains dissolved in the solution of tanning material. By itself, the salt is not injurious to hide or leather, and it has been assumed that it is likewise harmless when left in the tanning solution.

In the investigation which has been carried on at the Bureau of Standards it has now been shown that the neutralization of the sulphuric acid in the synthetic tanning materials by means of caustic soda or soda ash does not entirely prevent the sulphuric acid from reacting with hide or leather during the tanning process. This is because the synthetic tanning material is itself an active acid. This reacts with the sodium sulphate and regenerates some sulphuric acid, so that there is always a certain amount of free sulphuric acid in the solution. Moreover, it has been shown that sulphuric acid has a marked affinity for the hide substance and is capable of combining so firmly with the latter, even in the presence of the tanning material, that it cannot be completely removed with any amount of washing. Whether the acid thus combined with the hide is injurious to the latter, still remains to be determined.

Greeks Will Develop Pyrites Mines in Peloponnesus

Consul General Garrels at Athens reports that a group of Greeks recently acquired the rights to an iron pyrites mine on the eastern coast of the Peloponnesus, and contemplate developing the property as soon as additional capital can be raised.

PRODUCTION OF PYRITES IN EUROPE

	Metric Tons		
	1922	1923	1924
Spain			
Iron copper pyrites	1,871,509	2,163,554	1,615,233
Iron pyrites	468,080	488,987	597,132
Norway	397,470	377,513	405,443
Germany	328,724	193,028	159,623
France	*275,000	*275,000	*275,000
Greece	54,510	52,590	76,262
Sweden	57,321	58,297	66,353

*Estimated.

Just Rates Asked for Sulphuric Acid Shipments

The United Zinc Smelting Corporation has called upon the Interstate Commerce Commission to establish just and reasonable rates on sulphuric acid in tank-car loads from Moundsville, W. Va. to points in Pennsylvania and Ohio.

British Chemical Congress Stirs Interest in Industrial Problems

Important Symposiums on Corrosion, Industrial Efficiency and Waste Elimination, Liquid Fuels, and Paint and Rubber Research

Special Correspondence

AUSPICIOUS circumstances marked the opening in London on July 19 of the most distinguished gathering of chemists and chemical engineers ever held in Great Britain. The Annual Meeting of the Society of Chemical Industry and the Congress of Chemists brought together every British chemical interest in science and industry. Sixteen scientific societies and institutions co-operated with the Society of Chemical Industry in the four-day sessions that focussed attention on such important topics as industrial efficiency and waste elimination, the fundamentals of corrosion, liquid fuels from coal and alcohol, paint and rubber research and the scientific and industrial problems of biochemical investigation.

The award of the Messel Medal to the Rt. Hon. the Earl of Balfour, K.G., O.M., F.R.S., and the delivery of his impressive memorial lecture at the Mansion House in the presence of H.R.H. the Duke of York, K.G., and the Rt. Hon. the Lord Mayor, Sir William R. Pryke, gave an official color to the drabber scientific proceedings. The first exposition sponsored by the British Chemical Plant Manufacturers Association, held concurrently with the Congress, was a noteworthy feature and a very practical demonstration of the progress being made by those who serve the mechanical and chemical engineering needs of the industries. Some of the recent achievements exhibited there are discussed elsewhere by our London Correspondent.

I. C. E. Meeting

The first event of the week was the general meeting of the Institution of Chemical Engineers, which was marked by a masterly address on industrial efficiency and waste elimination, delivered by the Institution's president, Sir Frederic Nathan. As a definite instance of the application of process efficiency control, the speaker spoke of the British efforts during the war to increase the quantity of glycerine recovered by the soap makers and fat splitters. During 1917 the percentage recovery was 73.89 whereas under the stimulation of a process efficiency organization, the percentage recovery was increased to 81.54. Similar economies, as shown by the U. S. Department of Commerce, can be effected in many lines of industry.

In presenting the Messel Memorial Lecture Lord Balfour chose to discuss the future problems in obtaining liquid fuels from coal. He reported in view that the great fuel developments would more likely come from the hydrogenation of coal rather than from its low-temperature carbonization. Likewise he pointed out that the heavy chemical industries would become more and more dependent upon coal as a raw material as distinguished from coal as a source of power, light or heat.

Corrosion Symposium

Of considerable technical interest was the joint meeting on corrosion held by the British Chemical Plant Manufacturers' Association, the Institute of Metals, the Institution of Chemical Engineers and the Chemical Engineering Group of the Society of Chemical Industry. Ulick R. Evans in discussing the "Fundamental Principles of Corrosion" reviewed the various theories of corrosion and the principles covering its prevention in the elemental metals and in corrosion-resisting alloys. P. Parrish's paper was on Corrosion and Erosion related particularly to the problem involved in the manufacture of ammonium sulphate at gas and coke-oven works. In the early days when an acid product was produced the centrifugal baskets were often made of copper and the repairs and maintenance of centrifugal baskets and spindles cost in one large plant about 5d. per ton of sulphate produced. With the introduction of washing and neutralizing in the basket, the corrosion problem became more acute and costs mounted to 1s. 3d. Lately as a result of continued research and the use of phosphor bronze baskets, spindles, and steel gauzes the cost has been reduced to 7.4d. per ton. The ammonium sulphate saturators suffer more from erosion than erosion. It has been shown that the presence of cresols in the acid sulphate magma promotes corrosion.

Two additional papers which will be reviewed at greater langth in a subsequent issue of *Chem. & Met.* were on "Resistant Steels for Chemical Engineering," by Dr. W. H. Hatfield, and "Chemically Resistant Steels with Special Reference to Very High and Very Low Temperatures," by T. G. Elliot and G. B. Willey. Dr. Walter Rosenhain of the National Physical Laboratory, commenting on Mr. Parrish's paper, spoke of the polishing of the metal that made it more resistant to corrosion. He also confirmed the speaker's satisfactory experience with the use of rolled or forged Monel metal but believed that difficulties experienced with castings might be overcome when sufficient care was taken in the production and subsequent treating of the castings.

A second paper by Mr. Parrish that evoked much discussion was on the corrosion and erosion of chemical lead. The importance of this problem can be measured in terms of the large quantities of sheet lead used in the construction of sulphuric acid chambers and ammonium sulphate saturators. He discussed the question of purity, decomposition temperature, relation of copper content and the manufacture and testing of chemical lead.

The annual general meeting of the Society of Chemical Industry, with the retiring president, W. J. U. Woolcock, in the chair, reviewed the high-spots in the past year's activity of this "key" organization. It numbers in its present membership 4,802 and by cordial co-operative arrangements has the support of sixteen scientific and technical societies and institutions in addition to its own organization. For the coming year Mr. Woolcock is to be succeeded by Francis H. Carr, the director of British Drug Houses, Ltd. Another interesting meeting centered around the question of establishing a "Chemistry House" in London as a focal point for all activities relating to chemistry and chemical industry.

Sugar and Alcohol for the Future

The Institution of Petroleum Technologists and the Institution of Chemical Engineers joined with the Society of Chemical Industry in its meeting on "Power Alcohol." Dr. W. R. Ormandy's paper on "Sugar from Wood" was a very practical discussion of what has already been accomplished in the hydrolysis of wood cellulose and was most suggestive of potential results that will follow chemical advance in this direction. A second paper presented by Dr. Ormandy with Douglas Ross was entitled "Experiences with Alcohol Motor Fuels." He reviewed the extensive experimental work that has been done by the London General Omnibus Co. and by various other agencies that have studied the problem. Reduced to its simplest considerations, the problem is one of economies and the first utilization of alcohol fuels must come in the tropical and sub-tropical countries where sugar, starch and cellulose are rapidly and cheaply produced.

Still another symposium of industrial interest, and even more impressive than the others in the number contributing to it, was the joint meeting of the Institution of the Rubber Industry and the Oil and Colour Chemists' Association. The general subject "The Influence of Particle Size in the Paint and Rubber Industries" was opened by Dr. D. F. Twiss of the rubber industry and by Dr. H. H. Morgan and C. A. Klien of the paint industry. There followed eight specialized papers contributed by distinguished research workers from the two industries.

Bureau of Mines Seeks Man for Potash Prospecting

The Bureau of Mines is looking for a properly qualified man to take charge of the field work in connection with its potash prospecting. Director Turner had hoped to look over the ground personally, but other matters have arisen which likely will interfere with a trip to the Southwest at this time. It is hoped that arrangements can be made speedily with some engineer to take charge of the work in the field, but difficulties are anticipated as the salary which can be paid is not expected to be attractive to the type of man needed.

Men You Should Know About

C. F. BURGESS had conferred upon him the honorary degree of Doctor of Science by the University of Wisconsin at the Commencement Exercises in June. In conferring the degree President Frank said: "He has built up, upon the basis of pure science and experimental laboratories, a profitable and necessary industry that stands upon its merit alone in competition for public favor. His business is a service well conceived and adequately performed." Dr. Burgess was born in Oshkosh, Wis., and received his Bachelor of Science in electrical engineering from the University of Wisconsin in 1895 and the degree of Electrical Engineer in 1897. He was a member of the faculty from 1895 to 1913, during which time he established the courses in chemical engineering and applied electrochemistry.

Dr. C. F. Burgess

T. E. DOREMUS, manager of the explosives department of E. I. du Pont de Nemours and Co., at Seattle, Wash., has been appointed to the same position at New York, succeeding the late Frederick C. Peters.

M. E. HOLMES has accepted an appointment as head of the new ceramic department at the School of Mines and Metallurgy, University of Missouri, to be inaugurated with the fall term. He is a graduate of the University of Indiana and Cornell University. He was chemical director of the National Lime Association during the period in which he acted as general manager of that organization.

Prof. LAUDER W. JONES, head of the chemistry department, Princeton University, is visiting in Europe during the summer, completing an investigation of chemical research at different centers. He will return for the fall term at the University.

NED GUTHRIE, heretofore assistant in chemistry, University of Illinois, Urbana, has become head of the department of chemistry at Hanover College, Hanover, Ind., effective with the fall term, succeeding Dr. A. Harvey Young, deceased. Mr. Guthrie is a graduate of Hanover College.

Dr. HENRY E. KRAYBILL has assumed the position of state chemist of Indiana, to which he was recently appointed, and will maintain headquarters at Lafayette. He was formerly biochemist at the Boyce-Thompson Institute for Plant Research, Yonkers, N. Y.

HARRY T. BENNETT of Allentown, Pa., has been appointed chief chemist at the refinery of the Mid-Continent Petroleum Corp., West Tulsa, Okla., and has taken up his new duties.

JOHN J. WATSON, Jr., president of the International Agricultural Chemical Corporation, New York, has been decorated with the Cross of the Legion of Honor, recently conferred upon him by the President of France. He is now abroad with Mrs. Watson.

Dr. HENRY G. KNIGHT, formerly director of the West Virginia Agricultural Station, Morgantown, has been appointed dean at the West Virginia College of Agriculture, Morgantown, to succeed the late Dr. George R. Lyman.

B. J. C. VAN DER HOEVEN has left the Rockefeller Institute for Medical Research and jointed the Koppers Laboratories, Mellon Institute, Pittsburgh, doing field experimental work.

R. B. STRINGFIELD, who for the last four and a half years has been manager of Service Laboratories and on various special work with the Goodyear Tire and Rubber Co., Akron, Ohio, has been appointed chief chemist for the plant of the Goodyear Tire and Rubber Co. of California at Los Angeles. Mr. Stringfield was formerly with this company as chemical engineer.

PAUL A. BURY has accepted a position as research associate at the Bureau of Standards working under a fellowship of the National Lime Association. Mr. Bury left his work at Purdue University for the Bureau of Public Roads on August 1 to take up this new line of activity.

JOHN W. KENNEDY, formerly an instructor in the College of Engineering, University of Michigan, and until recently an administrative assistant in the Portland Cement Association, has been appointed engineer of the Huron Portland Cement Co., and the Wyandotte Portland Cement Co., to have charge of a new Service Bureau which is being established in Detroit, Mich.

Dr. R. H. PATCH, for the past 12 years with the Midvale Co. of Philadelphia, in various capacities, is now with E. F. Houghton and Co., also of Philadelphia, as engineering secretary to the President.

ROSS C. PURDY, secretary of the American Ceramic Society can now be addressed at 2525 North High Street, Columbus, Ohio.

EUGENE P. BROWN, formerly with the research department of the Standard Oil Co. of Indiana, has joined the staff of the Jenkins Petroleum Process Co., as assistant to the president. Mr. Brown will have charge of research for the company.

MACDONALD C. BOOZE, senior fellow of the Multiple Industrial Fellowship which is sustained by the American Refractories Institute at Mellon Institute of Industrial Research, University of Pittsburgh, has resigned to accept a position with the Charles Taylor Sons Company, Cincinnati, Ohio, as vice-president in charge of research and development. Stuart M. Phelps, who has been employed on the Refractories Fellowship since 1918, has been appointed director of research of the American Refractories Institute, effective July 1, 1926. Mr. Phelps will have charge of the investigational and testing activities of the fellowship.

M. C. Booze

Dr. JOSEPH H. SIMONS has resigned as head of the Chemistry Department of the University of Porto Rico to join the staff of the Chemistry Department at Northwestern University.

Prof. MARSTON TAYLOR BOGERT, senior professor of organic chemistry, Columbia University, has accepted the position of contributing editor of the *American Perfumer and Essential Oil Review*.

STEWART J. LLOYD has just returned from a ten weeks' trip abroad with Dr. Jones of the Nitrogen Engineering Corporation and Mr. Thurlow, the president of the Muscle Shoals Fertilizer Co., to look into the whole nitrogen fixation situation abroad.

Dr. GILBERT E. SEIL, formerly of the Koppers Research Laboratory at the Seaboard By-Products Coke Plant, Jersey City, N. J., has become associated with E. J. Lavino and Co. as technical director.

JOSEPH A. AMBLER, formerly chief of the Color Laboratory of the Bureau

of Chemistry, has returned after an extended absence, and is now engaged on organic research in the Carbohydrate Laboratory of the Bureau of Chemistry at Washington, D. C.

CHARLES J. MURRAY has recently resigned from the staff of the Linde Air Products Co., to become associated with the Oklahoma Contracting Co., which is organizing a new division to engage exclusively in oxwelded pipe line construction.

WALDO H. JONES has left the J. B. McCrary Co. to engage in consulting ceramic engineering, specializing in Southern clay properties such as kaolinitic lands and cement clays.

F. A. DALBURG of Ralston, Pa., has been placed in charge of the Bureau of Mines experiments in the mining of oil shale at Rifle, Colo.

JOHN W. MOONEY has been elected president of the Johnston Asbestos Company, Canada, in succession to the late A. S. Johnston.

J. V. N. DORR, president of The Dorr Co., sailed recently for Europe, where he expects to remain six weeks.

Obituary

Lothar Emil Weber

In the passing of Lothar Emil Weber the rubber industry has lost a unique and interesting personality. By energy and initiative he had succeeded in establishing a reputation as an advisor of marked ability and of the highest integrity. In view of his accomplishments, it is particularly sad to see him stricken while at the height of his powers and while still a young man.

Dr. Weber was born in Vienna on November 25, 1886, the son of C. O. Weber, one of the most illustrious advocates of the application of science to the study of rubber. While the son was very young, the family moved to England and later to America, and L. E. Weber was educated in the schools of Manchester, England, and Harvard University. Subsequently he received a doctorate from the University of Berlin in 1909.

Beginning his professional career as a chemist in the Hood Rubber Co. and then in research work at the Massachusetts Institute of Technology, his mind could never leave the subject to which his father devoted his life, and in 1911 he opened a laboratory of his own. From this time on his prestige increased until he became advisor to many important rubber companies. In more recent years he also became treasurer of the Acushnet Process Co. and director of research and development at the Fisk Rubber Company.

He contributed various articles to the technical press and culminated his literary activities with the publication of his recent book, "The Chemistry of Rubber Manufacture," a work which is not only the most recent but the most reliable treatise of its character on the subjects covered.

Aside from his professional activities and his interest in rubber, Dr. Weber was an intense lover of music and a devoted pianist.

Personally he was beloved and respected by all his friends as a man of wide intellect, sincerity and kindliness.

He is survived by a wife, who was Miss Sybilla Mittell of New York.

JOHN M. BIERER.

EDITOR'S NOTE.—Dr. Weber's recent book on "The Chemistry of Rubber Manufacture," which brings up-to-date

Lothar Emil Weber

and greatly extends the earlier editions of his father's text, will shortly be reviewed in these columns.

THEODORE P. KIMMAN, works manager of the Cleveland plant of the Chicago Pneumatic Tool Co., died at his home July 24 from heart disease.

JOSEPH W. COLEMAN, for the past 10 years treasurer and director of the Takamine Laboratories, Inc., Clifton, N. J., died at his local residence, July 30, aged 76 years. He was born at Hudson, N. Y., and during later years was prominently associated with the late Dr. Jokichi Takamine, well-known chemist.

ALEXANDER S. CATON, founder of the Viscoloid Co., Leominster, Mass., and president until his retirement five years ago, died July 24, at Ashville, N. C., aged 72 years.

WILLIAM HUBBELL GANO of Philadelphia, Pa., prominent in the field of scientific chemistry, died at his local residence, July 21, aged 64 years.

CHARLES A. COFFIN, founder and for thirty years head of the General Electric Co., as president and chairman of the board of directors, died July 14, at his home, Locust Valley, Long Island.

Calendar

AMERICAN CERAMIC SOCIETY, Bellevue-Stratford, Philadelphia, Pa., Aug. 30-Sept. 2.

AMERICAN CHEMICAL SOCIETY, Philadelphia, Pa., Sept. 6 to 11.

AMERICAN ELECTROCHEMICAL SOCIETY, Washington, D. C., Oct. 7, 8 and 9.

AMERICAN INSTITUTE OF CHEMICAL ENGRS., Atlanta, Ga., and Birmingham, Ala., Dec. 6 to 10.

AMERICAN WELDING SOCIETY, Fall meeting, Buffalo, Nov. 17, 18 and 19.

ASPHALT ASSN., The Assn. of Asphalt Technologists and the American Society for Municipal Improvements, will jointly and separately hold meetings, Mayflower Hotel, Washington, D. C., Nov. 8 to 12.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING (5th) Grand Central Palace, New York, Dec. 6 to 11.

SESQUI-CENTENNIAL INTERNATIONAL EXPOSITION, Independence Sq., Philadelphia, Pa., June 1 to Dec. 1.

SOUTHERN EXPOSITION (2nd Annual), Madison Sq. Garden, N. Y., Oct. 2-10.

TECHNICAL ASSN. OF THE PULP AND PAPER INDUSTRY, York, Pa., Sept. 14-16.

Industrial Notes

The Buffalo Wire Works Co., Inc., of Buffalo, N. Y. announces the election of John C. Scheeler as president, to succeed his father, the late Martin Scheeler.

The Link-Belt Co. of Chicago, Indianapolis and Philadelphia held its sixteenth conference at the Dodge Works, Indianapolis, for an intensive study of the products and the methods of production at the Dodge Plant, on July 7, 8, and 9. James S. Watson, general manager of the Dodge plant presided and fifty sales representatives from all sections of the country were present.

The Sullivan Machinery Co. moved its Boston office to Suite 701, 45 Milk Street.

The Formite-Childs Corporation will henceforth market and service all Amdyco generator products.

The American Trona Corporation, by consolidation with a corporation newly organized under Delaware law, has been changed to the American Potash & Chemical Corporation. The business continues as before with no change in directors, officers or personnel.

The Worthington Pump and Machinery Corporation, at a recent meeting of the Board of Directors, elected L. J. Belnap, president. C. Philip Coleman, retiring president was elected chairman of the board. Mr. Belnap was formerly president of Rolls Royce of America and chairman of Wills St. Claire Co. of Detroit.

The Clinchfield Products Corp., Erwin, Tenn., producers of feldspar, has been purchased by Herbert P. Margerum of Trenton, N. J., who also controls Golding Sons' Co. and Erwin Feldspar Co. Headquarters of the three companies are in the Trenton Trust Bldg., Trenton, N. J.

The Crowley Tar Products Company of New York has established temporary offices at 405 S. Hill Street, Los Angeles, California. D. L. Crowley who actively heads this company is taking charge of its interests in developing the turpentine industry in the pine forests near El Salto, Estate of Durango, Mexico.

Fred C. Henson has established the Fred C. Henson Company at 1234 East Walnut Street, Pasadena, California. This company manufactures instruments for scientific, laboratory and engineering purposes. Mr. Hensen was for a number of years on the instrument making staff of the Mt. Wilson Solar Observatory and for the past eight years has been instrument maker for California Institute of Technology.

The Denver Fire Clay Company, Denver, Colo. recently celebrated "A Half Century of Progress" in the manufacture of fire clay products.

Standard Turbine Corporation, Scio, New York, announces the appointment of C. R. Gould as its general manager. Mr. Gould has been identified with turbine manufacture for the past twenty years—most recently with the Kerr Turbine Company.

The Carborundum Co. of Niagara Falls, N. Y. announces that George R. Raynor, vice-president in charge of sales will continue as head of that department, with Williams MacGregor and S. F. Courter, as assistants. Both Mr. MacGregor and Mr. Courter will carry the titles of general sales managers, each being in charge of a sales division, and will succeed in the work of the late William Welsh Sanderson.

Market Conditions and Price Trends

Chilean Nitrate Industry Depressed By Competing Products

Increased Consumption of Synthetic Nitrogen Makes Heavy Inroads on the Field for the Natural Product

THAT the producers of Chilean nitrate are aroused thoroughly to the danger threatening their industry because of the rapidly mounting output of synthetic nitrogen is shown unmistakably by the resolutions adopted at the recent conference in Santiago, called by the Chilean Academy of Economic Sciences. The resolution, which leads the list, recites that it has been established that artificial nitrate is being sold in the work markets at prices lower than those asked for the natural product.

The necessity for reducing the price to the point where it can compete with fixed nitrogen is held to be apparent. In order to reduce cost, it is proposed to strive for more effective treatment processes; for economies in the use of fuel; for a wider use of mechanical equipment; for a reduction in the quantity of water used; for improved transportation facilities; for better port handling and lower ocean rates. In order to make the latter possible, it is suggested that the Chilean merchant marine may have to be stimulated.

As emergency measures to meet the existing situation, it is suggested that the export tax be reduced and the unrestricted sale of nitrates by the individual producers be allowed. This latter proposal would tend to concentrate production in the hands of the low-cost producers. It is suggested that half of the sacrifice, which is agreed upon, should be borne by the government. Emphasis is put on the need for finding new uses for iodine and for encouraging the production of nitrate of potash.

The conference was addressed by the Minister of the Treasury. He pointed out that a reduction in the export duty hardly would be granted, but if the industry should show due diligence in effecting economies that it reasonably may expect to be relieved of some of the requirements with regard to labor and of the duties recently imposed on coal and fuel oil.

Under Chilean Control

It was revealed at the conference that 60 per cent of the industry is in Chilean hands. All producers, except the two American companies, are members of the Nitrate Producers' Association. The Board of Directors of the Association, it was pointed out at the meeting, consists of thirteen Chileans and nine foreigners. Of the foreigners, two are British, three are Germans, three are Jugoslavians, and one is an American.

The Association maintains a committee in New York; another in London and a third in Berlin. Subordinate to them are forty "delegations" and "subdelegations" at different points throughout the world. The research department of the Association has a staff of fifteen chemists and engineers. The association is maintained by a levy of two pence on each metric quintal produced.

Decline in Exports

A report from commercial attaché Ralph H. Ackerman at Santiago says that the decline in export orders for nitrate of soda during recent months, has resulted in an increase of stocks in Chile ready for shipment at the end of June, which amounted to 1,200,000 tons, as compared with 850,000 tons at the same time last year. Production during June, 1926, fell to 170,000 metric tons, compared with 190,000 tons during June, 1925, while exports fell to the low level of 95,000 tons in contrast to 200,000 tons exported in June, 1925. Export shipments during the year ended June 30 aggregated 2,250,000 tons, as compared with 2,570,000 tons the previous fiscal year. Sales announced through the 26th of July have been very small.

Commenting on the recent meeting of the Nitrate Producers' Association with the representatives of European and American nitrate importers, he states that a reported reason for the meeting was to reach an agreement relative to a fall clause affecting stocks of Chilean nitrate in Europe bought at higher prices than are being quoted at present. The importers, it is understood, were not only concerned with securing a rebate on the existing stocks in their respective countries, but were particularly anxious to have the protective fall clause inserted in future contracts so as to insure themselves against any future lowering of prices on the part of the producers. The European importers, the cable indicates, also discussed the advisability of having the association name prices c.i.f. port of destination, instead of f.a.s.—Chilean nitrate ports as quoted at present. The meeting was understood to be unfruitful.

The Chilean Ministry of the Treasury has announced that the Government will make studies of the actual production costs of nitrate in order to intelligently act later, if necessary, concerning a reduction in export taxes which are equivalent to approximately 25 per cent of the selling price in Chile.

The nitrate industry places considerable weight upon increased production of synthetic nitrogen as an important reason for decreased consumption of the Chilean product. Lower prices for the synthetic product in Germany forced the June cut on Chilean nitrate, which was a move on the part of producers to meet competition without aid from the Chilean Government in the form of lower export taxes.

In connection with the competition offered by synthetic nitrates a report to Washington comments on the fact that quite a stir was caused among Chilean nitrate producers recently over the discharge at a Peruvian port in transit to Bolivia of 200 tons of German synthetic nitrate. Part of Bolivia adjoins the northern nitrate section of Chile and while the Chilean nitrate producers have felt keenly the synthetic competition in European markets they were apparently unprepared for reports of competition in a neighboring country. Incidentally a study of American statistics shows that during the past three years only one ton of fertilizer materials was exported to Bolivia direct from the United States.

Working Agreement Sought

A British report issued earlier in the year stated that there is also a feeling growing amongst nitrate producers in Chile that the time has come to consider some working agreement with the producers of other nitrogenous fertilizers, and as the world's consumption of nitrogen in different forms is increasing, it should be possible to divide up the world's markets amongst the various producers. By some such agreement a large economy all round might be brought about in such items as freight, warehouses, etc., doing away with much overlapping that takes place today. It might thus result that, whilst protecting the final consumer from too high a price, a general overhead reduction would be obtained, giving more satisfactory results to all concerned. It will be remembered that the conference which took place in 1921 between representatives of the Chilean Nitrate Producers, the British Sulphate of Ammonia Federation, and the German Stickstoff Syndicate upon this matter gave a negative result.

Imports of nitrate of soda into the United States in June were only 12,225 tons as compared with arrivals of 59,016 tons in June, 1925. World consumption of Chilean nitrates for the year ended June 30, 1926, totaled 2,077,000 long tons against 2,350,000 long tons for the preceding year.

Practically all important consumers except Germany and Egypt reduced their orders from 7 per cent to 34 per per cent below the amounts consumed in 1924-25. Consumption in the United States dropped 12 per cent. France registered the heaviest relative decline of 34 per cent.

Market Conditions and Price Trends

Production of Chemicals Showed Gain in First Half of Year

Distribution Among Consuming Industries Also Exceeded That for the Corresponding Six Months of Last Year

INDICATIONS point to a larger production of chemicals during the first half of this year than was the case in the corresponding period of 1925. Definite figures regarding the volume of output are lacking but the Federal Reserve Board has just reported that industrial production in the United States during the first half of 1926, when all lines are considered, was in greater volume than in the corresponding period of any previous year. Trade reports have agreed that activities have been on a high plane and distributors of chemicals generally have reported a steady movement into consuming channels.

An analysis of employment figures for chemical manufacturer and for the industries which are the principal buyers of chemicals, offers a basis of comparison which, may be translated into more or less definite terms.

In the accompanying table are shown the weighted index number of employment in the industries specified. They cover the six-month period for the last three years. These figures were compiled and given their weighted importance by the Department of Labor.

According to these comparisons slight decreases in consumption of chemicals took place in the first half of this year, as compared with 1925, in dyeing and finishing of textiles, in paper and pulp manufacture, and in the automobile tire industry. In the same period the fertilizer industry is shown to have exceeded 1925 operations by more than 10 per cent with an increase of nearly 8 per cent in glass manufacture and almost 9 per cent gain in petroleum refining. The production of chemicals also figures out as more than 3 per cent above that for the 1925 period. With due allowance for the relative importance of the different consuming trades it is probable that total consumption of chemicals was slightly in excess of the 3 per cent increase indicated for production especially as certain stocks are reported to have been smaller on June 30 than was the case in 1925.

Falling off in production and consumption of chemicals in July was to be expected and this undoubtedly has proved to be the case. On a basis of electrical energy consumed at plants during July and June a decline of 9.4 per cent is shown in the paper and pulp. In other lines declines are shown as follows: textiles 12.1 per cent, miscellaneous chemicals 4.4 per cent, cement and lime 4.3 per cent, clay and glass 4 per cent, and rubber 10.2 per cent. On the other hand the leather trade advanced 2.4 per cent, and the electrochemical trade 5.8 per cent.

Manufacturing production in June, according to the weighted index of the Department of Commerce, showed no change from the previous month, but was larger than a year ago, after adjustment for differences in the number of working days. The output of foodstuffs, textiles, nonferrous metals, lumber, leather, paper and printing, stone and clay products and tobacco was larger than in May, while iron and steel production and the output of chemicals and oils showed declines. As compared with a year ago, the production of textiles, iron and steel, lumber, paper and printing, chemicals and oils, stone, clay and glass products and tobacco was greater, while the output of foodstuffs and nonferrous metals was smaller.

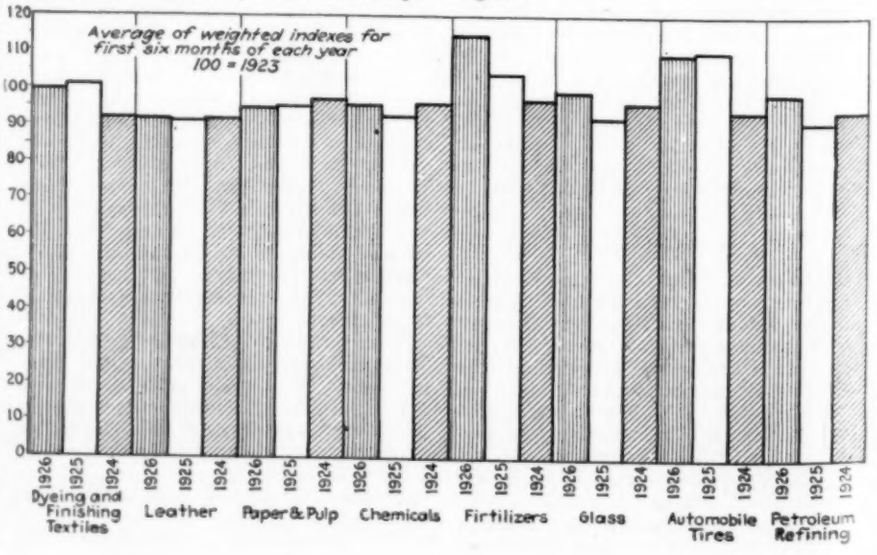
Stocks of commodities held at the end of June were smaller than at the end of the preceding month, but larger than a year ago, after adjustment for seasonal variations. Declines occurred in all major groups of commodities from the previous month, with a decline also from a year ago in the case of manufactured goods.

Both exports and imports of chemicals and allied products for the first six months of 1926 showed gains over the corresponding period of 1925, according to the Chemical Division of the Department of Commerce. Exports increased by 7 per cent, from an aggregate value of $79,172,000 in the 1925 period to $84,491,000 in 1926, and imports increased by 2 per cent, from $114,268,000 to $116,602,000.

In contrast to exports, imports were 7 per cent above the previous year's figure.

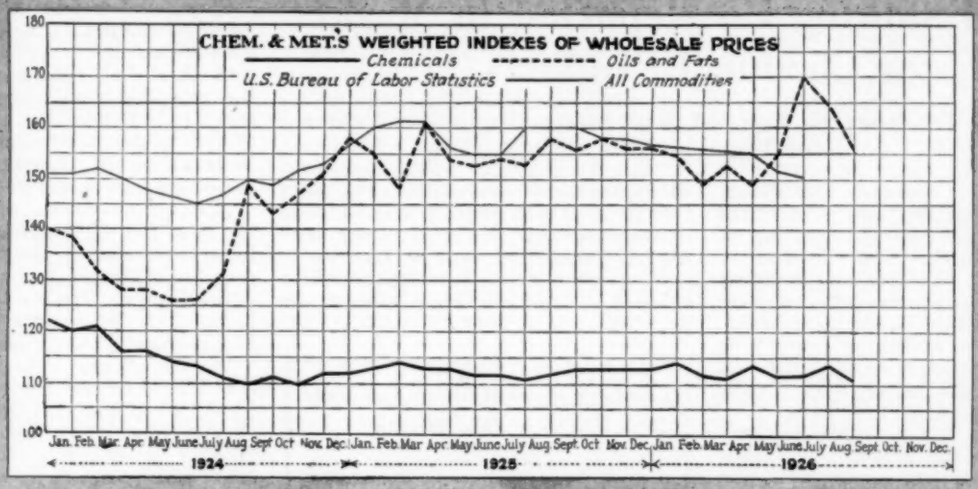
INDEX OF EMPLOYMENT IN INDUSTRIES CONSUMING CHEMICALS

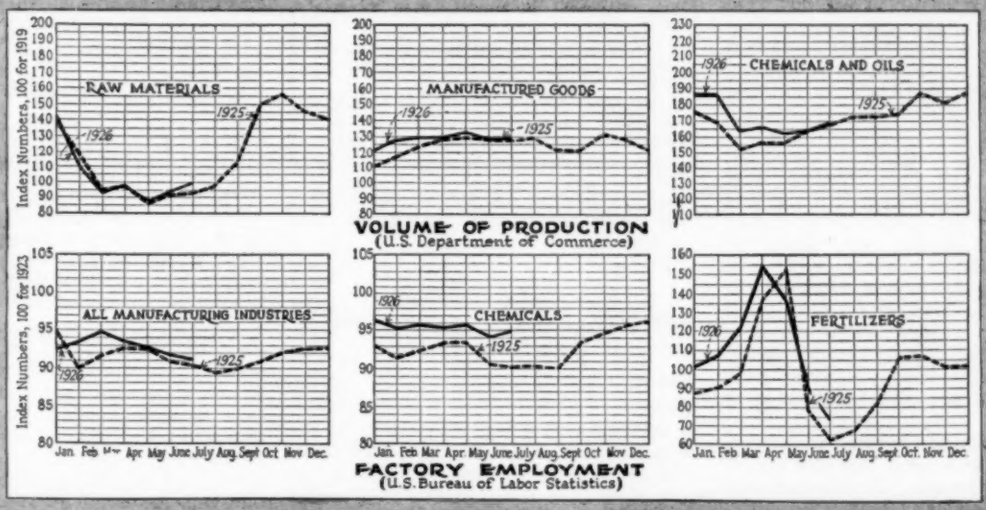
Dyeing and Finishing Textiles	Jan.	Feb.	Mar.	Apr.	May	June	Average
1926	101.4	101.4	101.6	99.7	97.3	95.9	99.6
1925	99.9	101.8	102.8	103.0	100.6	95.6	100.6
1924	84.1	95.6	94.8	94.0	91.0	88.4	91.3
Leather							
1926	92.6	93.3	93.4	91.1	89.3	86.7	91.1
1925	91.5	94.2	92.6	90.2	87.9	87.6	90.7
1924	94.7	96.5	94.3	90.5	86.1	83.5	90.9
Paper and pulp							
1926	95.1	95.3	95.6	86.1	96.4	95.9	94.1
1925	92.4	94.2	96.6	96.3	95.1	93.3	94.7
1924	96.5	97.4	96.8	96.6	95.9	94.9	96.4
Chemicals							
1926	95.3	95.3	95.4	95.7	94.1	94.6	95.1
1925	91.6	92.5	93.5	93.4	90.7	90.3	92.0
1924	99.7	99.5	98.4	96.9	92.9	85.6	95.5
Fertilizers							
1926	107.4	122.2	153.1	137.5	91.2	74.8	114.4
1925	91.0	98.0	137.4	153.0	78.9	62.3	103.4
1924	97.3	109.6	98.0	129.1	84.7	59.3	96.3
Glass							
1926	95.1	97.2	100.6	100.0	99.4	100.8	98.9
1925	88.2	91.1	92.7	94.1	91.6	92.0	91.6
1924	92.0	96.2	99.9	99.3	96.0	90.5	95.7
Automobile tires							
1926	112.6	113.7	111.8	111.6	107.8	106.8	109.1
1925	102.9	106.1	107.9	110.3	115.9	117.7	110.1
1924	90.3	93.6	95.5	95.3	94.8	92.3	93.6
Petroleum refining							
1926	97.6	98.0	97.4	98.9	98.8	100.9	98.6
1925	88.8	89.6	89.4	90.6	91.1	93.7	90.5
1924	92.5	93.1	93.1	93.8	93.8	93.8	93.4

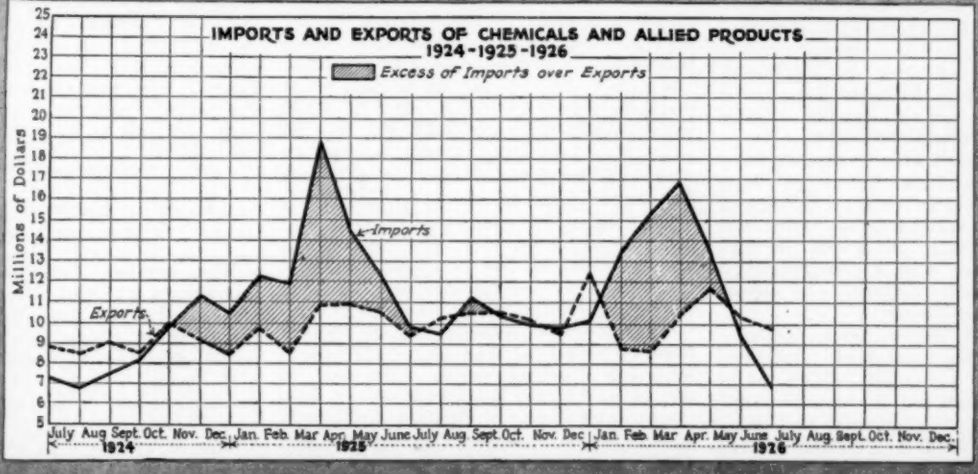


CHEM·&MET· Statistics of Business

In the Chemical Engineering Industries







Market Conditions and Price Trends

Seasonal Slowing Up Reported in Market for Chemical Products

Prices Show Tendency To Ease Off With Sharp Declines in Values for Vegetable Oils

CONSUMING demand for chemicals has been less active in recent weeks due to the seasonal position of manufacturing industries. Trading in the spot market has been along moderate lines and deliveries against contracts have involved smaller quantities. This condition is giving no concern as there is no depression in business and prospects for the latter part of the year are regarded as promising.

While many price changes have favored sellers the general trend has been toward lower levels and the weighted index number registers at 113.33 as compared with 113.66 a month ago and 111.67 a year ago. In some cases stocks on hand have increased sufficiently to bring out selling pressure and this has been a factor in lowering the index number. Basic chemicals, however, are holding a steady position and there is nothing to indicate that there is a downward trend to values.

The weighted index number for vegetable oils and fats dropped materially during the month. This was induced largely by revisions in values for cottonseed oil but was aided by declines in coconut, castor, and corn oils as well as by lower markets for animal fats. Linseed and China wood oils closed at higher levels than a month ago. The present index number is 156.50 which compares with 164.71 a month ago and 158.37 a year ago.

Among the price changes which attracted attention was a marking up of values for methanol. Production has been below normal and recent consumption has been large enough to reduce surplus stocks and thus create a firm situation. The probability of an increase in import duty also may have had something to do with the higher prices as such action may be expected to reduce competition from abroad. Following the advance in methanol, producers of formaldehyde announced a rise of 1¼c. per lb. in the asking price for that chemical.

A strong market also is reported for copperas. Producers have not been operating actively in view of the prices which had prevailed and with the gradual absorption of stocks it was found that there was a stringency of supplies for nearby delivery and values appreciated accordingly.

Easy tones, however, have featured the markets for coal-tars, fertilizer chemicals and sal soda which more than counter balanced the rise in other chemicals. Bleaching powder and caustic soda have held a steadier course than usual through the hot weather months and it is believed that surplus holdings are not large.

Some time ago it was reported that the government was conducting tests relative to the use of nitrite of soda in meat packing. Evidently these tests were favorable as an announcement has been sent from Washington which includes nitrite of soda among the materials which may be used in the meat industry. This may open up a new field for nitrite which will encourage larger production.

Leading Market Developments During the Month

Large supplies brought out competition in phenol and prices were lowered for spot and contract.

Nitrate of soda industry is depressed because of growing consumption of synthetic nitrates.

Domestic flaxseed crop lost ground in July and indicated yield is now placed at 19,090,000 bu.

Interest in calcium arsenate has increased and sales are reported at higher prices.

Reports from abroad say German interests have obtained control of a leading chemical company in France.

Sulphuric Acid Consumption in Fertilizer Trade

While no statistics from official sources have yet been issued relative to consumption of sulphuric acid in the fertilizer industry for the fertilizer year July, 1925, to June, 1926, it is evident that such consumption was larger than in the preceding year. The National Fertilizer Association has published figures showing production of acir phosphate for the July, 1925 to June, 1926 period. These figures are based on reports made by the different manufacturers of acid phosphate and, therefore, may be regarded as authoritative. They show that production of acid phosphate in terms of 16 p.c. was 3,979,426 tons in 1925-1926 and 3,482,030 tons in 1924-1925. In other words production was 14.3 per cent larger in the last fiscal year than in the preceding year. Assuming that consumption of sulphuric acid increased in like manner the amount used in the fertilizer industry in 1925-1926 would work out 2,631,862 tons expressed in terms of 50 deg. acid.

Taking the Bureau of Census figures for the 1924-1925, and 1923-1924 years, with due allowance for the difference in stocks on hand, consumption of sulphuric acid in the fertilizer trade in the last three fiscal years, compare as follows:

	Tons
1925-1926	2,631,862
1924-1925	2,302,592
1923-1924	2,110,705

Considered solely from the standpoint of sulphuric acid manufacture, these totals are favorable as they show that there has been a wider outlet in the principal consuming industry and make it probable that total production of acid in the twelve-month period was larger than in 1924-1925. The comparison is less favorable when attention is directed to stocks on hand. Stocks of bulk acid phosphate and available phosphoric acid at producing points on June 30, 1926 were reported at 1,013,207 tons as against 716,709 tons on June 30, 1925. This represents an increase of 41.4 per cent in stocks during the year.

In view of the large stocks on hand it is logical to look for a curtailment in phosphate production in the latter half of this year. This would be reflected directly in consumption of sulphuric acid which in turn would mean a smaller output of the latter in the fertilizer branch of the industry. Of course there is the possibility that demand for acid phosphate will increase sufficiently to absorb surplus stocks but it is more probable that sulphuric acid and acid phosphate production will be curtailed.

Phenol Moves Downward in Price Under Competition

Interest in the market for coal-tar chemicals has been directed toward phenol because of sharp price reductions which became effective on Aug. 1. Sellers are credited with booking large quantities on contracts at 16c. per lb. Values for spot goods also were lowered to 17@19c. per lb., according to seller. In accounting for the lower prices it is said that potential production is considerably larger than consumption and stocks have accumulated in sellers' hands. It is further stated that some producers are able to turn out this material at lower prices than formerly and are anxious to book business for forward positions in order to insure quantity productions at their plants. The bulk of this material is used in the production of phenolic resins and present production of phenol is estimated in some quarters at approximately 4,000,000 lb. Export figures are not shown separately in the official returns but they are not large enough to have any influence on the market.

Greater Interest Shown in Calcium Arsenate

The market for calcium arsenate has shown signs of life in the past two weeks. In the first place reports of weevil infestations have come from the cotton-growing sections of the Valley and from Texas. In addition leaf worms are said to be scattered throughout Texas. In the second place one holder of arsenate in the South is said to have initiated a selling campaign without regard to existing values and reports credit sales of about 1,500 tons at very low prices. Practically all the

Market Conditions and Price Trends

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**113.33**
Last month	113.66
August, 1925	111.67
August, 1924	110.22

Higher price levels were reached during the month by tin salts, copperas, copper sulphate, methanol and formaldehyde by the weighted index number was lower under the influence of declines in sulphate of ammonia, sal soda, and coal-tar chemicals, especially phenol.

buying orders called for Texas deliveries. Demand then showed a healthy increase and a good business was reported at steadily advancing prices. Buyers were looking for immediate deliveries and were willing to pay premiums for spot holdings. As a result some stocks of arsensate have been liquidated at prices which seemed improbable a month ago and the prospects were regarded as favorable for making large inroads on the supplies which have been held in southern states. Production of arsenate is still said to be at a standstill but new production may be rushed if the buying movement continues. The arsenic market has been quiet although fair demand has been coming from glassmakers, and if this is supplemented by orders from the insecticide trade it is probable that prices for arsenic will be advanced.

Sharp Advances Feature Trading in Methanol

In sharp contrast to position of methanol some months ago when imports of the synthetic product from Germany depressed the domestic industry was the announcement early this month that selling prices for domestic methanol had been marked up 10c. per gal. This change in conditions marks not only the lessened competition from synthetic methanol but also indicates a revival in consuming demand for the home product. Export buying also has involved larger volumes and June returns show that 37,811 gal. of crude and refined methanol was shipped out in that month as compared with 17,853 gal. in June, 1925. Shipments of crude methanol from domestic plants in June amounted to 797,594 gal. which was in excess of the production of 540,076 gal. In the same period Canada shipped 26,474 gal. from plants as against a production of 24,115 gal. In the first six months of the year shipments from both Canadian and American plants have been larger than the amounts produced and this has meant a corresponding decrease in surplus stocks. With demand running ahead of supply it was natural to look for a firmer market. Additional strength to prices may be found in the belief that producers will meet with success in their efforts to obtain an increase in import duty under the flexible features of the tariff law. The brief filed with the Tariff Commission, in behalf of 53 producers and refiners of methanol asks for an increase in duty from 12c. to 18c. per gal. and is based primarily on the statement that the present duty does not equalize the difference in costs in production in the United States and the principal competing countries.

Statistics showing production and shipments of crude methanol in the United States and Canada for the first six months of the year are as follows:

	Production, Gal.	Shipments, Gal.	Stocks, End of Month, Gal.
	United States		
1925			
June	587,271	596,291	1,866,632
Total (6 mos.)*	3,843,580	3,647,719	.....
1926			
January	698,263	661,123	1,358,541
February	*631,245	*815,824	*1,166,835
March	684,430	*617,522	*1,264,656
April	709,051	583,639	1,418,617
May	643,476	629,671	1,442,842
June	540,076	797,594	1,230,692
Total	3,906,541	4,105,373	.....
	Canada		
1925			
June	20,992	14,400	17,514
Total (6 mos.)*	220,948	205,869	.....
1926			
January	45,917	39,572	48,787
February	42,705	46,554	48,830
March	36,038	44,267	46,343
April	30,017	32,062	41,210
May	30,424	35,791	42,046
June	24,115	26,474	40,137
Total	209,216	224,720	.....

Flaxseed Crop Made Poor Progress in July

On Aug. 10 the Department of Agriculture issued a report showing condition of the flaxseed crop as of Aug. 1. Condition was given as 65.2 per cent, yield per acre at 6.7 bu. and total indicated yield 19,090,000 bu. The progress of the crop to date with comparisons for last year is shown as follows:

	Condition	Yield per Acre Bu.	Total Yield Bu.
July 1, 1926	73	7.0	19,886,000
Aug. 1, 1926	65.2	6.7	19,090,000
July 1, 1925	81.6	7.5	26,100,000
Aug. 1, 1925	75.4	7.6	23,500,000

Changes for the month in the principal producing states are shown below:

	Indicated Yield— July, Bu.	August, Bu.
Minnesota	7,243,000	7,725,000
North Dakota	8,205,000	7,504,000
South Dakota	,802,000	2,235,000
Kansas	- 240,000	268,000
Montana	1,037,000	992,000

The Dominion Bureau of Statistics estimates the present crop in Canada at 6,437,000 bu. as compared with 9,297,100 bu. the final estimate on the crop of last year. It is evident therefore that the North American crop will fall far short of filling consuming needs and considerable seed will have to be imported from the Argentine. It has been estimated that the Argentine and India can ship nearly 33,000,000 bu. in the latter half of this year which exceeds estimates of consumption in that period.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**169.79**
Last month	154.49
June, 1925	153.87
June, 1924	126.30

Numerous price changes have characterized trading in vegetable oils and fats. Linseed oil is higher than a month ago and a strong situation has arisen in the china wood oil market. On the other hand sharp declines have occurred in cottonseed, and corn oils with lower prices also ruling for castor, coconut and palm oils as well as tallow and greases.

The Department of Commerce reports domestic production of linseed oil at 145,328,656 lb. in the quarter ended June 30. This makes a total production of 339,935,694 lb. for the first half of the year, whereas consumption in that period was 206,185,440 lb. Factory and warehouse stocks on June 30 were 128,556,548 lb.

One of the features of the month was the sending of the first bulk shipment of linseed oil from New York to San Francisco via the Panama Canal. It consisted of about 800 tons of oil and was consigned to a leading paint manufacturer.

Imports of Chemicals

	June 1926	June 1925
Dead or creosote oils, gal.	10,306,706	13,470,404
Pyridine, lb.	72,206	38,694
Arsenic, lb.	3,126,377	3,082,833
Acid, citric, lb.	3,248	78,400
Acid, formic, lb.	121,649	100,610
Acid, oxalic, lb.	122,687	129,260
Acid, sulphuric, lb	5,981,798	6,218,260
Acid, tartaric, lb.	187,912	76,705
Ammonia chloride, lb.	868,305	747,143
Ammonia nitrate, lb.	1,223,779	2,100
Barium compounds, lb.	4,402,990	1,670,150
Calcium carbide, lb.	1,000,510	955,900
Copper sulphate, lb.	111,045	146
Bleaching powder, lb.	393,226	221,447
Potassium cyanide, lb.	11,243	65,513
Potassium carbonate, lb.	1,018,972	204,062
Potassium hydroxide, lb.	1,301,830	681,193
Potassium chlorate, lb.	710,546	752,243
Sodium cyanide, lb.	2,166,396	2,545,360
Sodium ferrocyanide, lb.	44,514	44,435
Sodium nitrate, lb.	135,404	521
Sodium nitrate, ton	12,225	59,016
Sulphate of ammonia, ton	36	387

Exports of Chemicals

	June 1926	June 1925
Benzol, lb.	4,081,723	135,981
Aniline oil and salt, lb.	1,167	134,018
Acid, acetic, lb	41,226	55,290
Acid, boric, lb.	196,159	68,764
Acid, sulphuric, lb.	453,315	660,490
Methanol, gal.	37,811	17,853
Aluminum sulphate, lb.	4,455,121	3,126,959
Acetate of lime, lb.	2,234,702	1,497,608
Calcium carbide, lb.	583,301	655,561
Bleaching powder, lb.	2,730,994	4,029,699
Copper sulphate, lb.	199,238	372,851
Formaldehyde, lb.	124,435	238,319
Potassium bichromate, lb.	8,990	74,532
Sodium bichromate, lb.	733,458	525,561
Sodium cyanide, lb.	60,755	204,826
Borax, lb.	2,843,020	2,854,847
Soda ash, lb.	4,016,130	2,876,950
Sodium silicate, lb.	3,936,663	3,079,717
Sal Soda, lb.	1,007,297	822,487
Caustic soda, lb.	8,255,793	7,563,864
Sulphate of ammonia, ton	19,106	9,580
Sulphur, ton	50,098	49,650

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to August 16.

Industrial Chemicals

		Current Price	Last Month	Last Year
Acetone, drums	lb.	$0.12 -$0.13	$0.12 -$0.13	$0.12 -$0.13
Acid, acetic, 28%, bbl.	cwt.	3.25 - 3.50	3.25 - 3.50	3.00 - 3.25
Boric, bbl.	lb.	.09 - .10	.09 - .10	.08½- .10
Citric, kegs	lb.	.44½- .45	.45 - .47	.45½- .47
Formic, bbl.	lb.	.10½- .11½	.10 - .11	.10½- .10½
Gallic, tech., bbl.	lb.	.50 - .55	.45 - .50	.45½- .47
Hydrofluoric 30% carb.	lb.	.06 - .07	.06 - .07	.06½- .07
Lactic, 44%, tech., light, bbl.	lb.	.13½- .14	.13½- .14	.13½- .14
22%, tech., light, bbl.	lb.	.06½- .07	.06½- .07	.06½- .07
Muriatic, 18°, tanks	cwt.	.80 - .85	.80 - .85	.80 - .85
Nitric, 36°, carboys	cwt.	.05 - .05½	.05 - .05½	.04½- .04½
Oleum, tanks, wks.	ton	18.00 -20.00	18.00 -20.00	16.00- 17.00
Oxalic, crystals, bbl.	lb.	.10½- .11	.10½- .11	.10½- .11
Phosphoric, tech., c'bys.	lb.	.07 - .07½	.07 - .07½	.07½- .08
Sulphuric, 60°, tanks	ton	10.50 -11.00	9.50 -11.00	8.00 - 9.00
Tannic, tech., bbl.	lb.	.35 - .40	.35 - .40	.45 - .50
Tartaric, powd., bbl.	lb.	.29 - .30	.29 - .30	.27½- .30
Tungstic, bbl.	lb.	1.00 - 1.20	1.00 - 1.20	1.20 - 1.25
Alcohol, ethyl, 190 p'f. U.S.P., bbl.	gal.	4.90 - 5.00	4.90 - 5.00	4.85 - 4.90
Alcohol, Butyl, dr.	lb.	.18 - .18½	.18½- .19	.27 - .30
Denatured, 190 proof				
No. 1 special dr.	gal.	.29 - .40	.29 - .40	.48½-
No. 5, 188 proof, dr.	gal.	.29 - .32	.29 - .32	.47½-
Alum, ammonia, lump, bbl.	lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl.	lb.	.05½- .05½	.05½- .05½	.05½- .06
Potash, lump, bbl.	lb.	.02½- .03½	.02½- .03½	.02½- .03½
Aluminum sulphate, com., bags	cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg.	cwt.	2.00 - 2.10	2.00 - 2.10	2.40 - 2.45
Aqua ammonia, 26°, drums	lb.	.03½- .04	.03½- .04	.06 - .06½
Ammonia, anhydrous, cyl.	lb.	.13 - .15	.13 - .15	.28 - .30
Ammonium carbonate, powd. tech., casks	lb.	.07½- .08½	.08½- .10	.12½- .12½
Sulphate, wks.	cwt.	2.40 -	2.55 -	2.55 -
Amylacetate tech., drums	gal.	1.75 - 1.85	1.80 - 2.00	2.75 - 3.00
Antimony Oxide, bbl.	lb.	.16 - .16½	.14½- .15	.16 - .16½
Arsenic, white, powd., bbl.	lb.	.03½- .04½	.03½- .04½	.03½- .04½
Red, powd., kegs	lb.	.11 - .11½	.11 - .11½	.13½- .14
Barium carbonate, bbl.	ton	55.00 -56.00	51.00 -52.00	48.00 -50.00
Chloride, bbl.	ton	63.00 -65.00	63.00 -65.00	58.00 -60.00
Nitrate, cask	lb.	.07½- .08	.07½- .08½	.07½- .08
Blanc fixe, dry, bbl.	lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums	cwt.	2.00 - 2.10	2.00 - 2.10	1.90 -
Borax, bbl.	lb.	.05 - .05½	.05 - .05½	.05 - .05½
Bromine, cs.	lb.	.45 - .47	.45 - .47	.47 - .48
Calcium acetate, bags	cwt.	3.25 - 3.50	3.25 - 3.50	2.75 - 2.80
Arsenate, dr.	lb.	.06½-	.07½-	.06 - .08
Carbide drums	lb.	.05½- .06	.05 - .06	.05 - .05½
Chloride, fused, dr., wks.	ton	21.00 -	21.00 -	21.00 -
Phosphate, bbl.	lb.	.07 - .07½	.07 - .07½	.06½- .07½
Carbon bisulphide, drums	lb.	.05½- .06	.05½- .06	.06 - .06½
Tetrachloride drums	lb.	.06½- .07	.06½- .06½	.07 - .07½
Chlorine, liquid, tanks, wks.	lb.	.04 - .04½	.04 - .04½	.04½-
Cylinders	lb.	.05½- .08	.05½- .08	.05½- .08
Cobalt oxide, cans	lb.	2.10 - 2.20	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks.	ton	16.00 -20.00	15.00- 18.00	13.00 -14.00
Copper carbonate, bbl.	lb.	.17 - .17½	.16½- .18	.16½- .17
Cyanide, tech., bbl.	lb.	.49 - .50	.49 - .50	.49 - .50
Sulphate, bbl.	cwt.	4.90 - 5.00	4.85 - 4.95	4.50 - 4.60
Cream of tartar, bbl.	lb.	.21 - .22	.21 - .22	.21 - .21½
Epsom salt, dom., tech., bbl.	cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags	cwt.	1.30 - 1.40	1.30 - 1.40	1.35 - 1.40
Ethyl acetate, 85% drums	gal.	.80 - .82	.82 - .85	.87 - .90
99%, dr.	gal.	1.01 -	1.01 -	1.03 - 1.06
Formaldehyde, 40%, bbl.	lb.	.10½- .10½	.09 - .09½	.09 - .09½
Furfural, dr.	lb.	.15 - .17½	.17½-	.23 -
Fusel oil, crude, drums	gal.	1.35 - 1.40	1.40 - 1.50	2.70 - 3.00
Refined, dr.	gal.	2.50 - 3.00	2.50 - 3.00	4.00 - 4.50
Glaubers salt, bags	cwt.	1.00 - 1.15	1.15 - 1.25	1.20 - 1.40
Glycerine, e.p., drums, extra	lb.	.30 - .32	.30 - .32	.19 - .19½
Lead:				
White, basic carbonate, dry, casks	lb.	.10½-	.10½-	.10½-
White, basic sulphate, sck.	lb.	.10 -	.10 -	.09½-
Red, dry, sck.	lb.	.12 -	.11½-	.12½-
Lead acetate, white crys., bbl.	lb.	.14½- .15	.14½- .15	.14½-
Lead arsenate, powd., bbl.	lb.	.14 - .15	.14 - .15	.13 - .14
Lime, chem., bulk	ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk.	lb.	.11½-	.11 -	.11½-
Lithopone, bags	lb.	.05½- .06	.05½- .06	.06 - .06½
Magnesium carb., tech., bags	lb.	.06½- .06½	.06½- .06½	.06½- .07
Methanol, 95%, dr.	gal.	.65 - .68	.57 - .62	.58 - .62
97%, dr.	gal.	.67 - .72	.59 - .64	.60 - .64
Nickel salt, double, bbl.	lb.	.10 - .10½	.10 - .10½	.09 - .10
Single, bbl.	lb.	.10½- .11	.10½- .11	.10 - .11
Orange mineral, csk.	lb.	.14½-	.13½-	.15½-
Phosphorus, red, cases	lb.	.62 - .65	.68 - .70	.70 - .75
Yellow, cases	lb.	.32 - .33	.34 - .36	.37½- .40
Potassium bichromate, casks	lb.	.08½- .08½	.08½- .08½	.08½- .08½
Carbonate, 80-85%, calc., csk.	lb	.05½- .06	.06 -	.06 - .06½
Chlorate, powd.	lb.	.08½- .09	.08½- .09	.07½- .08
Cyanide, cs.	lb.	.55 - .57	.55 - .58	.47 - .62
First sorts, csk.	lb.	$0.09 -$0.09½	$0.08½-$0.09	$0.08½-$0.08½
Hydroxide(c'stic potash) dr.	lb.	.07½- .07¾	.07½- .07¾	.07½- .07½
Muriate, 80% bgs.	ton	34.90 -	34.90 -	34.55 -
Nitrate, bbl.	lb.	.06 - .06½	.06½- .06½	.06 - .07½
Permanganate, drums	lb.	.14 - .15	.14½- .15	.14½- .15
Prussiate, yellow, casks	lb.	.18½- .18½	.18½- .18½	.18½- .18½
Sal ammoniac, white, casks	lb.	.05½- .06	.05½- .06½	.05½- .06
Salsoda, bbl.	cwt.	.85 - .95	.95 - 1.05	1.10 - 1.20
Salt cake, bulk	ton	17.00 -18.00	17.00 -18.00	17.00 -19.00
Soda ash, light, 58%, bags, contract	cwt.	1.38 -	1.38 -	1.38 -
Dense, bags	cwt.	1.45 - 1.55	1.45 - 1.55	1.45 - 1.55
Soda, caustic, 76%, solid, drums, contract	cwt.	3.10 -	3.10 -	3.10 -
Acetate, works, bbl.	lb.	.05 - .05½	.04½- .05	.05 - .05½
Bicarbonate, bbl.	cwt.	2.00 - 2.25	2.00 - 2.25	1.75 - 2.00
Bichromate, casks	lb.	.06½- .06½	.06½- .06½	.06½- .06½
Bisulphate, bulk	ton	5.00 - 5.50	5.00 - 5.50	6.00 - 7.00
Bisulphite, bbl.	lb.	.03½- .04	.03½- .04	.04½- .04½
Chlorate, kegs	lb.	.06½- .06½	.06½- .06½	.06½- .07
Chloride, tech.	ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom.	lb.	.18 - .22	.18 - .22	.19 - .22
Fluoride, bbl.	lb.	.08½- .09	.08½- .09	.09 - .09½
Hyposulphite, bbl.	lb.	2.50 - 3.00	2.65 - 3.00	.02½- .02½
Nitrate, bags	cwt.	2.34 -	2.57½-	2.47 -
Nitrite, casks	lb.	.08½- .09½	.08½- .09	.09 - .09½
Phosphate, dibasic, bbl.	lb.	.03½- .03½	.03½- .03½	.03½- .03½
Prussiate, yel. drums	lb.	.10½- .10½	.10 - .10½	.10½- .10½
Silicate (30°, drums)	cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sulphide, fused, 60-62%, dr.	lb.	.03 - .03½	.03 - .03½	.02½- .03
Sulphite, crys., bbl.	lb.	.03 - .03½	.02½- .03	.02½- .03
Strontium nitrate, bbl.	lb.	.08½- .09	.09 - .10	.09½- .10
Sulphur, crude at mine, bulk	ton	19.00 -	19.00 -	14.00 -16.00
Chloride, dr.	lb.	.05 - .05½	.05 - .05½	.04½- .05
Dioxide, cyl.	lb.	.09 - .10	.09 - .10	.08½- .09
Flour, bag	cwt.	2.70 - 3.00	2.70 - 3.00	2.25 - 2.35
Tin bichloride, bbl.	lb.	.17½-	.17 -	.16½-
Oxide, bbl.	lb.	.66 -	.64 -	.62 -
Crystals, bbl.	lb.	.43 -	.41½-	.40½-
Zinc chloride, gran., bbl.	lb.	.07 - .07½	.07 - .08	.06 - .07½
Carbonate, bbl.	lb.	.11 - .11½	.10½- .11	.12 - .14
Cyanide, dr.	lb.	.40 - .41	.40 - .41	.40 - .41
Dust, bbl.	lb.	.09 - .10	.09 - .10	.08 - .08½
Zinc oxide, lead free, bag.	lb.	.07½-	.07½-	.07½-
5% lead sulphate, bags.	lb.	.07 -	.07 -	.06½-
Sulphate, bbl.	cwt.	2.75 - 3.00	3.00 - 3.50	3.50 - 3.75

Oils and Fats

		Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.	lb.	$0.11½-$0.13	$0.12½-$0.13	$0.16 -$0.16½
Chinawood oil, bbl.	lb.	.18 -	.15 -	.13½- .14
Coconut oil, Ceylon, tanks, N. Y.	lb.	.10 -	.10½-	.10½-
Corn oil crude, tanks, (f.o.b. mill)	lb.	.10½-	.12½-	.09½-
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.11 -	.12½-	.10 -
Linseed oil, raw, car lots, bbl.	lb.	12.3 -	11.4 -	14.0 -
Palm, Lagos, casks	lb.	.08½- .09	.08½- .9½	.09½- .09½
Niger, casks	lb.	.08½-	.08½-	.09 -
Palm Kernel, bbl.	lb.	.10½-	.10 - .10½	.09½-
Peanut oil, crude, tanks (mill)	lb.	.13 -	.12½-	.09½-
Perilla, bbl.	lb.	-	.15 - .15½	.14½-
Rapeseed oil, refined, bbl.	gal.	.92 - .95	.90 - .92	.97 - .98
Sesame, bbl.	lb.	-	-	.15 - .15½
Soya bean tank (f.o.b. Coast)	lb.	.10½-	.10½-	.11½-
Sulphur (olive foots), bbl.	lb.	.08 -	.08½-	.08 -
Cod, Newfoundland, bbl.	gal.	.62 - .65	.60 - .65	.62 - .63
Menhaden, light pressed, bbl.	gal.	.65 - .67	.65 - .67	.78 - .80
Crude, tanks (f.o.b. factory)	gal.	.47½- .50	.55 -	.55 - .58
Whale, crude, tanks	lb.	-	-	-
Grease, yellow, loose	lb.	.07½-	.08½-	.08½- .09
Oleo stearine	lb.	.11½-	.14 -	.11 - .11½
Red oil, distilled, d.p. bbl.	lb.	.10 - .10½	.11½- .11½	.11½- .11½
Tallow, extra, loose	lb.	.08 -	.09 -	.08½-

Coal-Tar Products

		Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl.	lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl.	lb.	.85 - .90	.90 - .95	.75 - .80
Alpha-naphthylamine, bbl.	lb.	.35 - .36	.35 - .36	.35 - .36
Aniline oil, drums, extra	lb.	.15 - .16	.16 - .16½	.16 - .16½
Aniline salts, bbl.	lb.	.22 - .24	.20 - .22	.20 - .22
Anthracene, 80%, drums	lb.	.60 - .65	.60 - .65	.65 - .70
Benzaldehyde, U.S.P., dr.	lb.	1.15 - 1.25	1.30 - 1.35	1.50 -
Benzidine base, bbl.	lb.	.70 - .72	.72 - .75	.78 - .80
Benzoic acid, U.S.P., kgs.	lb.	.58 - .60	.56 - .60	.75 - .85
Benzyl chloride, tech, dr.	lb.	.25 - .26	.25 - .26	.35 - .36
Benzol, 90%, tanks, works	gal.	.25 - .28	.25 - .28	.23 - .24
Beta-naphthol, tech., drums	lb.	.22 - .24	.22 - .24	.24 - .25
Cresol, U.S.P., dr.	lb.	.18 - .20	.18 - .20	.23 - .25
Cresylic acid, 97%, dr., wks.	gal.	.59 - .65	.63 - .71	.59 - .62
Diethylaniline, dr.	lb.	.58 - .60	.58 - .60	.59 - .61
Dinitrophenol, bbl.	lb.	.31 - .35	.30 - .33	.35 - .38
Dinitrotoluen, bbl.	lb.	.17 - .18	.16 - .17	.18 - .20
Dip oil, 25% dr.	gal.	.28 - .30	.28 - .30	.26 - .28
Diphenylamine, bbl.	lb.	.45 - .47	.48 - .50	.48 - .50
H-acid, bbl.	lb.	.63 - .65	.68 - .72	.70 - .74

Coal-Tar Products—Continued

	Current Price	Last Month	Last Year
Naphthalene, flake, bbl. lb.	$0.05½-$0.06	$0.05½-$0.06	$0.05 -$0.05½
Nitrobenzene, dr. lb.	.09 - .10	.09½- .10	.09 - .10
Para-nitraniline, bbl. lb.	.45 - .48	.50 - .53	.65 - .67
Para-nitrotoluine, bbl. lb.	.28 - .32	.30 - .35	.40 - .42
Phenol, U.S.P., drums. lb.	.17 - .19	.22 - .24	.23 - .25
Picric acid, bbl. lb.	.30 - .40	.30 - .40	.20 - .22
Pyridine, dr. lb.	4.10 -.....	4.10 -.....	4.10 - 4.20
R-salt, bbl. lb.	.47 - .50	.40 - .44	.50 - .55
Resorcinal, tech, kegs. lb.	1.30 - 1.35	1.35 - 1.40	1.30 - 1.40
Salicylic acid, tech., bbl. lb.	.30 - .32	.33 - .34	.32 - .33
Solvent naphtha, w.w.,tanks.gal.	.35 -.....	.35 -.....	.25 - .26
Tolidine, bbl. lb.	.90 - .95	.95 - .96	1.00- 1.05
Toluene, tanks, works. gal.	.35 -.....	.35 -.....	.26 -.....
Xylene, com., tanks. gal.	.36 - .41	.36 - .41	.26 - .27

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl. ton	$23.00-$25.00	$23.00-$25.00	$17.00-$17.50
Casein, tech., bbl. lb.	.17½- .20	.16½- .18½	.13 - .14
China clay, powd., f.o.b. Va.ton	10.00 -20.00	10.00 -20.00	12.00 -15.00
Imported, powd. ton	45.00 -50.00	45.00 -50.00	45.00 -50.00
Dry colors:			
Carbon gas, black (wks.) lb.	.08 - .08½	.08 - .08½	.06½- .08
Prussian blue, bbl. lb.	.32 - .33	.32 - .34	.35 - .37
Ultramine blue, bbl. lb.	.08 - .35	.08 - .35	.08 - .35
Chrome green, bbl. lb.	.28 - .30	.28 - .30	.27 - .29
Carmine red, tins. lb.	5.00 - 5.10	5.00 - 5.10	4.25 - 4.50
Para toner. lb.	.85 - .90	.90 - .95	.95 - 1.00
Vermilion, English, bbl. lb.	1.45 - 1.50	1.40 - 1.45	1.40 - 1.45
Chrome yellow, C. P., bbl.lb.	.17 - .18	.17½ - .18	.18½- .19
Feldspar, No. 1 (f.o.b. N. C.)ton	6.00 - 6.50	6.00 - 6.50	6.50 - 7.00
Graphite, Ceylon, lump, bbl. lb.	.07 - .09½	.07 - .09½	.08 - .09½
Gum copal, Congo, bags. lb.	.09½- .10	.09½- .10	.08 - .10
Manila, bags. lb.	.15 - .18	.14 - .16	.14 - .16
Damar, Batavia, cases. lb.	.25 - .25½	.25 - .26	.28½- .28¾
Kauri, No. 1 cases. lb.	.55 - .57	.57 - .65	.58 - .62
Kieselguhr (f.o.b. N. Y.) ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc. ton	44.00 -.....	38.00 -40.00	35.00 -40.00
Pumice stone, lump, bbl. lb.	.05 - .07	.04½- .08	.05 - .05½
Imported, casks. lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H. bbl.	14.15 -.....	13.00 -.....	11.50 -.....
Turpentine. gal.	.98 -.....	.86 -.....	.98 -.....
Shellac, orange, fine, bags. lb.	.29 - .30	.29 - .30	.62 - .65
Bleached, bonedry, bags. lb.	.36 - .40	.33 - .35	.67 - .69
T. N. bags. lb.	.27 - .28	.26 - .27	.58 - .59
Soapstone (f.o.b. Vt.), bags. ton	10.00 -12.00	9.50 -10.00	7.50 - 8.00
Talc, 200 mesh (f.o.b. Vt.) ton	11.00 -.....	11.00 -.....	10.50 -.....
200 mesh (f.o.b. Ga.) ton	7.50 -10.00	7.50 -10.00	8.00 -12.00
325 mesh (f.o.b. N. Y.) ton	14.75 -.....	14.75 -.....	14.75 -.....
Wax, Bayberry, bbl. lb.	.21 - .22	.20 - .22	.21 - .21½
Beeswax, ref., light. lb.	.47 - .48	.46 - .47	.38 - .39
Candelilla, bags. lb.	.34 - .35	.36 - .37	.32 - .33
Carnauba, No. 1, bags. lb.	.50 - .51	.48 - .49	.37 - .38
Paraffine, crude 105-110 m.p. lb.	.05½- .06	.06 - .06¼	.06¼-.....

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%. ton	$200.00-.....	$200.00-.....	$200.00-.....
Ferrochromium, 1-2%. lb.	.23- .25	.23- .35	.24-.....
Ferromanganese, 78-82%. ton	88.00-90.00	88.00-90.00	115.00-.....
Spiegeleisen, 19-21%. ton	32.00-34.00	33.00-34.00	32.00-.....
Ferrosilicon, 10-12%. ton	33.00-38.00	33.00-38.00	39.50-43.00
Ferrotungsten, 70-80%. lb.	.95- 1.05	1.10- 1.15	.90- ...
Ferro-uranium, 35-50%. lb.	4.50-.....	4.50-.....	4.50-.....
Ferrovanadium, 30-40%. lb.	3.25- 4.00	3.25- 4.00	3.25- 3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic. lb.	$0.14¼-.....	$0.14 -.....	$0.14¼-$0.15¼
Aluminum, 96-99%. lb.	.27 - .28	.27 - .28	.27 - .28
Antimony, Chin. and Jap. lb.	.15½- .16	.19½- .23	.20½-.....
Nickel, 99%. lb.	.35 -.....	.34 -.....	.31 - .32
Monel metal, blocks. lb.	.32 - .33	.32 - .33	.32 - .33
Tin, 5-ton lots, Straits. lb.	.64½-.....	.62½-.....	.57½-.....
Lead, New York, spot. lb.	8.40 -.....	8.25 -.....	.09 -.....
Zinc, New York, spot. lb.	7.65 -.....	.08½-.....	.07½-.....
Silver, commercial. oz.	.63½-.....	.67 -.....	.63½-.....
Cadmium. lb.	.60 -.....	.60 -.....	.60 -.....
Bismuth, 500-lb. lots. lb.	2.70 - 2.75	2.65 - 2.70	1.30 - 1.35
Cobalt. lb.	3.00 -.....	2.50 -.....	2.50 - 3.00
Magnesium, ingots, 99%. lb.	.75 - .80	1.00 -.....	.90 - .95
Platinum, ref. oz.	111.00-.....	112.00-.....	117.00-.....
Palladium, ref. oz.	69.00- 71.00	87.50- 88.00	78.00-.....
Mercury, flask. 75 lb.	90.50-.....	91.00-	79.00-80.00
Tungsten powder. lb.	1.10- 1.15	1.20-.....	.95- 1.00

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks. ton	$5.50- $8.50	$5.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post. ton	22.50- 25.00	21.00- 24.00	18.50- 24.00
Coke, fdry., f.o.b. ovens. ton	3.75- 4.25	3.75- 4.25	4.75- 5.00
Fluorspar, gravel, f.o.b. Ill. ton	18.00-.....	18.00-.....	17.50- 18.50
Ilmenite, 52% TiO_2, Va. lb.	.01½-.....	.01½-.....	.01½-.....
Manganese ore, 50% Mn., c.i.f. Atlantic Ports. unit	.35 - .36	.40 - .42	.42 - .43
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y. lb.	.50 - .55	.55 - .70	.60- .70
Monazite, 6% of ThO_2. ton	120.00-.....	120.00-.....	120.00-.....
Pyrites, Span. fines, c.i.f. unit	.13½-.....	.13½-.....	.11½- .12
Rutile, 94-96% TiO_2. lb.	.12 - .15	.12 - .15	.12 - .15
Tungsten, scheelite, 60% WO_3 and over. unit	12.50 -13.00	12.50 -13.00	9.50 - 9.75
Vanadium ore, per lb. V_2O_5 lb.	.30 - .35	.30 - .35	1.00 - 1.27
Zircon, 99%. lb.	.03 -.....	.03 -.....	.06 - .05

Current Industrial Developments

New Construction and Machinery Requirements

New England

Mass., Cambridge—J. W. Greer Co., plans 2 story 65 x 80 ft. addition to plant for the manufacture of confections, on Windsor St. Estimated cost $40,000. Architect and engineer not selected.

Mass., Everett (Boston P. O.)—Beacon Oil Co., 111 Devonshire St., Boston, is having plans prepared for the construction of a 3 story, 40 x 110 ft. addition to oil plant, on Beacham St., here. Estimated cost $60,000. Private plans.

Mass., Everett (Boston P. O.)—Mustone Products Corp., Union City, N. J., awarded contract for the construction of a 1 and 2 story factory on Tremont Ave., here, to F. C. Fellows & Son, 47 High St., Boston. Estimated cost $40,000.

Middle Atlantic

N. J. Kearny—Wiloyle Refineries, Inc., subsidiary of Wilson Oil Corp., 415 Lexington Ave., New York City, plans expanding plant, here. W. H. Wilson is vice-president.

N. J., Metuchen—C. Kulow and S. Rednor, et al, Trenton, plan additions and remodeling tile works on Middlesex Ave., here.

N. J., Newark — United States Industrial Alcohol Co., 110 East 42nd St., New York City, has purchased the plant of the New Jersey Alcohol & Chemical Corp., at 400 Doremus Ave. and plans extensions and additions.

N. Y., Binghamton — Binghamton Gas Works, Chenango St., is having revised plans prepared for the construction of a 2 story, 60 x 145 ft. service and mechanical repair building, here. Estimated cost $75,000. Conard & Cummings, Phelps Bldg., are architects.

N. Y., Buffalo — Nehrbass Rendering Wks., Williams St., Cheektowaga, plans the construction of fertilizer plant, recently destroyed by fire. Estimated cost $25,000.

Pa., Copley—Copley Cement Mfg. Co. plans expanding plant here. Owners will install addition grinding equipment, etc. Estimated cost $750,000.

Pa., Enola—State Dept. of Agriculture, Harrisburg, awarded contract for the construction of a 1 story, 31 x 100 and 50 x 106 ft. laboratory, here, to C. W. Strayer, 13th and Thompson Sts., Harrisburg, Pa.

Pa., Philadelphia—Ajax Metal Co., 46 Richmond St., smelters and refiners, will build 1 story, 21 x 50 ft. manufacturing plant at 110th and Dunton Sts. Work will be done by separate contracts under the supervision of M. W. Easly Co., 1505 Race St., engineer.

Pa., Philadelphia—Crescent Ink & Color Co., 460 North 5th St., awarded contract for the construction of 1 story, 29 x 52 ft. factory addition on 5th and Hamilton Sts., to J. Sims Wilson Co., 1125 Brown St.

Pa., Spring Mills—Walker Bros., plans the construction of a 1 and 2 story, 69 x 115 ft. addition to Moorehead Clay Works, near here. Ballinger Co., 12th and Chestnut Sts., Philadelphia, is architect.

Pa., Universal—Universal Portland Cement Co., Carnegie Bldg., awarded contract for the construction of 1 story stockhouse to McDonald Engr. Co., 53 Jackson Blvd., Chicago, Ill., $237,848.

Pa., Upper Darby — Delaware Hospital will receive bids until August 28, for sterilizing and disinfecting equipment.

Pa., Watsonville—Watsonville Fertilizer Co. plans the construction of a plant to replace factory recently destroyed by fire. Estimated cost $25,000. Complete equipment will be purchased.

South

Ala., Birmingham — Anc-co Preserving Co., C. A. Jones, 2211 Avenue E, awarded contract for the construction of canning plant, here, to Bessemer Eng. & Constr. Co., 104 North 15th St. Estimated cost $35,000.

Ala., Birmingham — E. I. du Pont de Nemours, Willmington, Del., plans the construction of a plant for high explosives and dynamite, on 1,240 acre site, 10 miles from here. Estimated cost $2,000,000.

Ga., Valdosta — Southeastern Chemical Co. has taken over the local mill of Georgia Fertilizer & Oil Co. and plans remodeling and additions. Estimated cost $25,000. Additional machinery will be purchased.

Ky., Ashland—Big Run Coal & Clay Co. has work underway on the construction of a hollow tile plant, here. Estimated cost $75,000. Equipment will be purchased. C. A. Coleman is president.

La., Bastrop—Louisiana Pulp & Paper Co. will build 100 x 564 ft. brick, steel and stone addition to pulp paper plant, here. Work will be done by company forces. Estimated cost $1,000,000.

Miss., Pascagoula—J. H. Pelham, c/o J. H. Pelham Co., plans the construction of a modern seafood cannery, on newly acquired riverfront site, here.

N. C., Colon—Isenhour Brick Co. plans enlarging capacity of brick plant from 30,000 to 100,000 bricks per day.

Tenn., Summitville—Tennessee Lime & Cement Co., Tullahoma, is having plans prepared for the construction of a cement plant, here. Estimated cost $40,000.

Middle West

Ill., Chicago — American Colortype Co., 1151 Roscoe St., is receiving bids for the construction of a 2 story, 140 x 160 ft. addition to factory. Estimated cost $175,000. Condron & Post, 53 West Jackson St., are engineers.

Ill., Chicago—Armour & Co., 208 South La Salle Blvd., is having plans prepared for the construction of a 5 story, glue cook house. Estimated cost $151,000 R. C. Clark, c/o owner, is architect.

Ill., Chicago — A. Epstein, 2001 North Pershing Rd., Archt., will receive bids about August 25, for the construction of 1 story, 108 x 185 ft. candy factory at 3342 Iron St., for Central Manufacturing District. Estimated cost $70,000.

Ill., Chicago — Federated Drug Co., 825 East 39th St., will receive bids until August 21 for the construction of 2 story, 50 x 300 ft. factory, on 3635 Iron St. Estimated cost $75,000. A. Epstein, 825 East 39th St., is architect.

Ill., Chicago—Liquid Carbonic Corporation plans to take over and expand the plant of the Liquid Carbonic Co., at 3100 South Kedzie Ave. Estimated cost $4,000,000.

Ill., Chicago — Raymond Bros. Impact Pulverizer Co. plans the construction of 1 story, 100 x 250 ft. addition to plant, 1235 North Branch St. H. Hanselmann, 37 South Wabash Ave., is architect.

Ill., Chicago—Star Paper Co., 450 North Hermitage Ave., has had plant prepared for the construction of a 3 story, 72 x 110 ft. addition, at 1734-38 West Austin Ave. Estimated cost $45,000. M. L. Bein, 64 West Randolph St., is architect.

Ind., Indianapolis—Hide-Leather Belting Co., 227 South Meridian St., is receiving bids for the construction of 2 story and basement, 55 x 120 ft. factory. Estimated cost $75,000. F. S. Cannon, 21 Virginia Ave., is architect.

Mich., Detroit—Sears Paper Co., Lynne and Magra Sts., Saginaw, awarded contract for the construction of 6 story, 120 x 300 ft. plant here, to H. G. Christman, South Bend, Ind. Estimated cost $300,000.

O., Cleveland—Forbes Varnish Co., 3800 West 143d St., E. S. Reed, Pres. and Genl. Mgr., awarded contract for the construction of a 1 story, 43 x 83 ft. laboratory, at 3800 West 143d St., to J. C. F. Shafer Co., Smythe Bldg. Estimated cost $40,000.

O., Cleveland — Frankelite Co., 5016 Woodland Ave., D. Frankel, Pres., awarded contract for the construction of 4 story factory, to L. Dautel & Son, 5710 Hough Ave. Estimated cost $40,000.

O., Cleveland—Willard Storage Battery Co., 246 East 131st St., R. C. Noberg, Vice-Pres., has had plans prepared for the construction of 4 story, 135 x 300 ft. factory on Taft Ave. and East 131st St. Estimated cost $250,000. P. H. Voth, c/o owner, is architect.

O., Fairport Harbor—P. C. Tomson & Co., 27 Washington St., Phila., Pa., awarded contract for the construction of 2 story, 121 x 221 ft. factory for manufacture of lye and washing powders, etc., to Mitzel-Shields, B. F. Keith Bldg., Cleveland. Estimated cost $150,000.

O., Fostoria—National Carbon Co., West 117th St. and Madison Ave., Cleveland, M. W. Allen, Mgr., is having plans prepared for the construction of group of 12 buildings of from 1 to 5 stories. Estimated cost $1,500,000. Stone & Webster, 24 Federal St., Boston, Mass., are engineers and architects.

O., Lectonia — Standard Porcelain Co., East Liverpool, plans 4 kiln electric porcelain factory, here. Estimated cost $40,000.

O., Middletown—Crystal Tissue Co. is having preliminary plans prepared for the construction of paper mill. Estimated cost $80,000. Z. E. Ranck is president.

Wis., Cudahy—Federal Rubber Co., subsidiary of Fisk Rubber Co., 250 West 57th St., New York City, awarded contract for the construction of 6 story, 68 x 286 ft. factory to Siderits Constr. Co., 3rd and North Ave., Milwaukee. Owner will purchase special machinery.

Wis., Fond du Lac—Galloway-West Co., Tompkins St., is receiving bids for the construction of 2 story, 56 x 95 ft. dry milk plant here. Estimated cost $40,000. R. A. Sutherland, Commercial Bank Bldg., is engineer.

Wis., Kohler—Kohler Co., awarded contract for the construction of substructure of 3 story, 130 x 600 ft. and 1 story, 340 x 328 ft. pottery plant, here, to Immel Constr. Co., Dana Bldg., Fond du Lac. Estimated cost $1,000,000. Bids will soon be received on superstructure.

Wis., Milwaukee—Badger Paint Stores, 337 3rd St., awarded contract for the construction of 2 and 4 story, 62 x 100 ft. factory, on State St., to H. Schmitt & Son, 14 Burleigh St. Estimated cost $40,000. Paint making machinery will be purchased.

Wis., Milwaukee—Layton Co. Muskego Ave. will build 2 story, 62 x 100 ft. rendering plant on Muskego Ave. Estimated cost $70,000. Work will be done by day labor.

Wis., Milwaukee—Pittsburgh Plate Glass Co., 205 Lake St., two 2 story 60 x 130 ft. and 50 x 50 ft. and one 1 story, 40 x 50 ft. factory on Oregon St., to H. Danischefsky, 1488 Humboldt Ave. Estimated cost $100,000.

Wis., Nenosha—Valley Paper Mill Co., H. H. Heed, pres., plans the construction of 60 x 150 ft. paper mill, here. Estimated cost $60,000. Engineer and architect not selected.

Wis., New Diggings—Mineral Point Zinc Co., Mineral Point, W. R. Smith, Genl. Supt., will build 60 x 96 ft. wet zinc mill, here. Estimated cost $40,000. Work will be done by day labor.

Wis., Racine—Wright Rubber Products Co., Layard St. and R.R. tracks, plans the construction of a 2 story, 60 x 62 ft. factory addition, here. F. J. Hoffman, Janes Bldg., is architect.

Wis., Sheboygan—Badger State Tannery Co., A. W. Welman, South Water St. is receiving bids for the construction of 2 story, 60 x 85 ft. tannery, here. Estimated cost $40,000. Private plans.

Wis., Two Rivers — Wisconsin Public Service Corp., 559 Marshall St., Milwaukee, awarded contract for the construction of 2 story gas plant, to Western Gas Constr. Co., Fort Wayne, Ind. Estimated cost $200,000.

West of Mississippi

Minn., Cloquet — Northwest Paper Co., R. M. Weyerhauser, Pres., plans the construction of a 100 x 190 ft. main building, and 3 story, 50 x 70 ft. office building, here. Estimated cost $100,000. Jacobson Eng. Co., 430 Oak Grove Ave., is engineer.

Mo., Fulton—A. P. Green Fire Brick Co., Mexico, soon receives bids for the construction of a 1 story, 60 x 500 ft. brick plant, near here. $250,000.

Mo., Knasas City—Corn Products Co., 17 Battery Pl., New York City, awarded contract for the construction of sugar house, here, to Bedford Constr. Co., 208 Illinois St., Chicago, Ill. Estimated cost $100,000.

Mo., North Kansas City—U. S. Gypsum Co., plans the construction of a 1, 2 and 3 story chipboard manufacturing plant, here. Estimated cost $400,000. Private plans.

Mo., St. Louis—Evens & Howard Fire Brick Co., 90 Market St., awarded contract for the construction of 1 story, 40 x 396 ft. stiff mud unit and tunnel kiln, for brick manufacturing plant, on North and South Rd. between Clayton and Manchester Rds., to C. B. Harrop Co., 310 West Broad St., Columbus, O. Estimated cost $100,000.

Neb., Lyman—Great Western Sugar Co., Sugar Bldg., Denver, Colo., plans the construction of a sugar beet refinery, near here. Estimated cost $850,000. Equipment will be purchased.

Okla., Enid—Champlin Refining Co. plans improvements to refining plant to include two 2,000 bbl. cross cracking stills, 5 to 10 centrifuge machines, additional chilling tanks, etc. Work will be done by company forces. Estimated cost $80,000. Private plans.

Okla., Tulsa — Sand Springs Chemical Co. plans the construction of a plant for the production of calcium chloride salts, etc., here. O. Martin is president.

Texas—E. E. Dix & Sons, 321 Bedell Bldg., San Antonio, plans developing 50,000 acres in Jim Wells, Brooks and Hidalgo Counties, including canning and packing plans for citrus fruits. Estimated cost $3,000,000 to $4,000,000.

Texas — Humble Oil & Refining Co., Houston, reported hving work underway on the construction of a casinghead gasoline plant, in Parrott Field, Throckmorton Co. Estimated cost $500,000.

Tex., Houston—Texas Salt Co., 1st Natl. Bank Bldg., plans the construction of a 60 x 360 ft. evaporating plant at salt mines, here. G. Leland is president.

Tex., Val Verde (mail El Paso)—Val Verde Industries awarded contract for the construction of a 1 story canning plant to T. T. Hopper, Post-Despatch Bldg., Houston. Estimated cost $100,000.

Tex., Wichita Falls — Wichita Falls Brick & Tile Co. awarded contract for the construction of brick plant, including brick making machinery to Reid & Costley, Wichita Falls, $41,000.

Far West

Calif., Long Beach—City plans the construction of a gas plant, 5,000,000 cu.ft. daily capacity at West Anaheim St. Estimated cost $200,000. Private plans.

Ore., Portland—Oregon-Washington Refining Co., Board of Trade Bldg., plans the construction of a refinery and other plant additions. Estimated cost $1,500,000.

Wash., Longview—Long View Fiber Co. plans the construction of 1st unit of mill for manufacture of pulp, pulp products, paper, etc. Estimated cost $2,500,000. M. A. Werthemer is president.

Wash., Olympia—Olympia Pulp & Paper Co. plans the construction of a paper plant, at Boston Harbor, here. Company was recently incorporated with $750,000 capital stock. M. Lemon is president.

Canada

Ont., Clinton — Board of Education, awarded contract for the construction of 2 story, 100 x 120 ft. chemistry and physics laboratory, on Main St., to A. Ivey, c/o S. B. Coon & Son, 4 St. Thomas St., Toronto. Estimated cost $100,000. Owners will purchase complete laboratory equipment.

Ont., Fort William—Fort William Paper Co., plans enlarging the capacity of newsprint plant from 150 to 400 tons per day. Estimated cost $10,000,000.

Ont., London—Kellogg Co. of Canada, awarded contract for the construction of 4 story, 150 x 150 ft. factory on Dundas St., to Sullivan & Fried, 81 Victoria St., Toronto. Estimated cost $125,000. Owners are in market for special equipment for the manufacture of breakfast foods.

Ont., Oakville—Marlatt Leather Co., Forsythe St., is having plans prepared for the construction of 2 or 3 story factory addition at plant. Estimated cost $40,000. D. C. Cotton, Center Rd., Port Credit, is architect.

Ont., Sault Ste. Marie—Algoma Steel Corp., Saulte Ste. Marie, awarded contract for the construction of a coke screening plant, to Heyl & Patterson, 51 Water St., Pittsburgh, Pa. Estimated cost $250,000.

Ont., Saulte Ste. Marie—Dominion Tar & Chemical Co., Wilde St., awarded contract for the construction of a tar distributing plant, here, to McLarty Bros., 33 Wellington St. Estimated cost $60,000.

Ont., Sault Ste Marie—Dominion Tar & Chemical Co., Wilde Ave., plans the construction of a distilling plant, here. Estimated cost $40,000-$60,000. Complete equipment will be purchased.

Ont., Toronto—Consumers Gas Co., 19 Toronto St., awarded contract for the construction of condenser building, at gas plant, to Wells & Gray, Confederation Life Bldg. Estimated cost $90,000.

Ont., Toronto—Womens College Hospital, 125 Rusholme Rd., is having plans prepared for hospital including dispensing laboratory, etc. on Rusholme Rd. Estimated cost $500,000. Stevens & Lee, 62 Charles St., are engineers.

Que., Limoilou — Angelo Canadian Pulp & Paper Co., Ltd., 511 St. Catherine St., W. Montreal, awarded contract for the construction of mill here to Northern Constr. Co., Ltd., Keefer Bldg., Montreal. Cost to exceed $1,000,000.

T. H., Hilo—Pacific Guano & Fertilizer Co., c/o Dickey & Wood, Damon Bldg., Honolulu, Archts., is having plans prepared for the construction of a factory, here. Estimated cost $150,000.